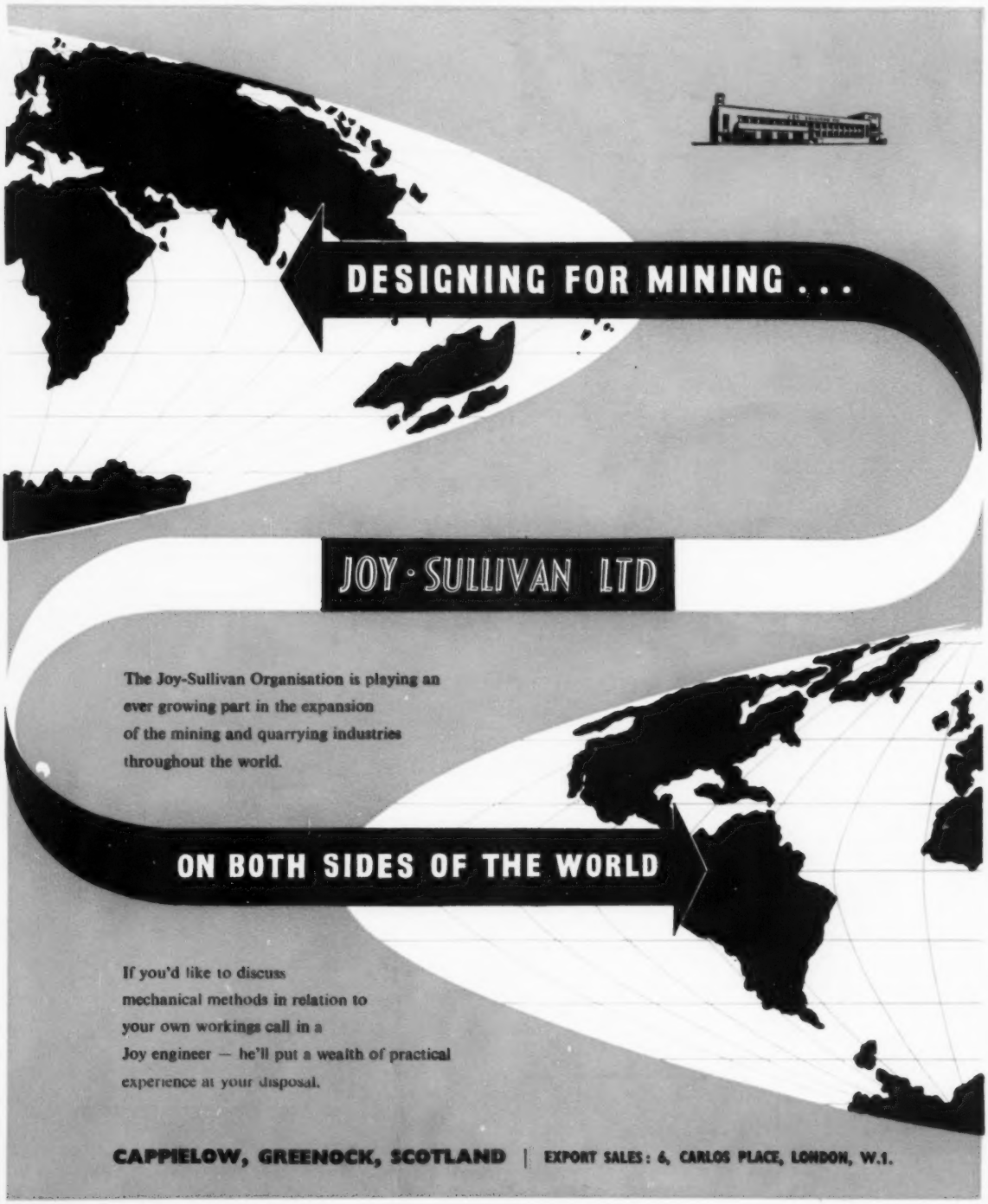
Annual Review 1956

The Mining Journal

Railway & Commercial Gazette

ESTABLISHED 1835 | LONDON, MAY, 1956 | PRICE 7/6d.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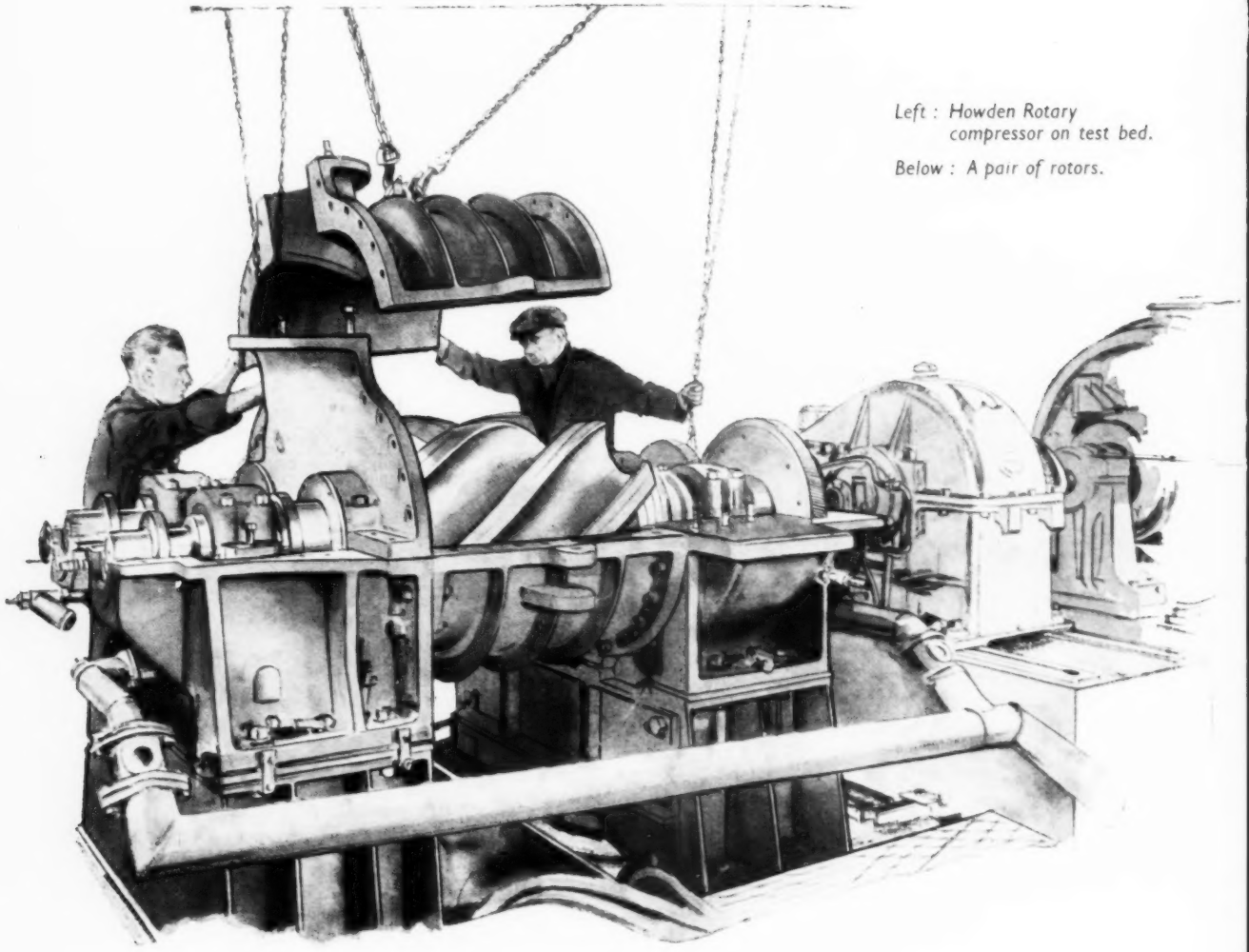

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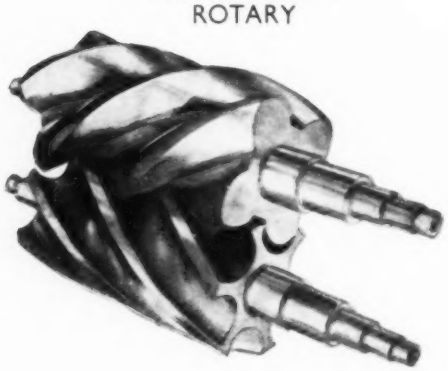

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The Mining Journal

ANNUAL REVIEW—1956

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Publishers: The Mining Journal, Ltd., 15 Wilson Street, Moorgate, London, E.C.2

The Outlook for Mining

ONCE again the compilation of this Annual Review provides us with the opportunity of thinking back over the recent trend of events in the mining industry and, in the process, of contemplating the shape of things to come, perhaps in bolder outline than we have the opportunity of doing in pursuance of our weekly task of " bringing the world's mining news to the world's mining men ".

In surveying this prosperous industry, which has been in a state of almost continuous expansion since the eve of World War II, our point of departure still remains the virtual certainty that, whatever the short-term fluctuations, we must in the long run prepare ourselves to meet a vastly expanding demand for all metals and fuels. This proposition even embraces a metal like tin, the demand for which continues to rise, albeit slowly, despite the inroads of substitution and conservation. Besides tin, the relative importance of other metals and fuels (of copper in relation to aluminium or of coal in relation to uranium) is changing and will continue to change, but such is the expansionist pressure exerted by industry everywhere that, seemingly, the growth of demand upon every section of the minerals industry is assured, the relative decline in the usage of certain metals being reflected in a correspondingly slower rate of expansion.

The performance of metals in use, especially of some of the " newer " metals, is also becoming more and more important, and already it has become pertinent to consider how far technological progress in such fields as high speed aircraft and guided missiles and in the growing automation industry is being retarded by the failure of the extraction metallurgist to deliver to an acceptable standard.

To return to the quantitative aspect of the problem, the great bulk of the demand on the world's mining industry still comes from the United States which today absorbs over ten times as much copper, lead, zinc and aluminium *per capita* as the average for the rest of the world. Not only are the indications that U.S. population trends, coupled with ever-increasing mechanization, will cause this demand to grow, but of greater potential significance are the signs of increasing consumption, not only in the highly-industrialized centres of Europe but in many of the under-developed areas of the world where, as often as not, it is an expanding mining industry which is itself laying the foundations of industrialization.

It may be argued that U.S. stockpiling has been a major factor in the consistently strong markets of recent years, but while this is undoubtedly true, the influence of stockpiling may in retrospect prove to have been less than we are inclined to think. In practice U.S. stockpiling has, especially in the past two or three years, been carried out with considerable flexibility. The intake, for example, of copper, aluminium and nickel has been cut back or suspended in the face of acute consumer shortage, while intake of lead and zinc has already become purely a price support operation. Beyond this, quite a lot of metal going to the stockpile has been produced as the result of government-sponsored projects, many of which, as in the case of nickel and copper, were sub-economic, at least at prices ruling when the contracts were placed. Under depressed market conditions the output from these projects would go to the stockpile so long as the contracts were in force, while thereafter the deposits would presumably not be worked.

What, in the long view, is likely to be of far greater importance than stockpiling, which indeed is already in the majority of cases either tapering off or is completed, is the position of Russia in the world's markets. Although she can afford to be a net exporter of a few metals such as platinum, manganese or gold, she, quite as much as the United States, is a " have-not " country for many other mineral requirements, at least until the potential resources of her vast territories have been fully explored. Meanwhile, if her economy expands in the way her planners clearly intend that it should, we have in prospect in that country a deficiency of indigenous metals probably greater in scale than that which the U.S. already has to meet through imports. Such a situation is going to make mining — more especially in the under-developed areas — a vital political counter, which may well be decisive in determining the foreign policies both of the United States and Russia.

The States has already developed a pattern in its dealings with the world's under-developed mining areas. Broadly, it is one of financial and technical aid to be repaid directly or indirectly in metal. It remains to be seen how the Russian initiative will develop. In Asia it is already noticeable that the emphasis is on co-operation rather than aid but we have yet to see whether Russian know-how is exportable, while for the moment the restrictions on shipments through the Iron Curtain are such that we cannot assess the eventual impact of Russian demand on Europe, Africa or South America. However, it is clear that Russia means to trade wherever and whenever she can and, in considering the long term picture, it would be unrealistic to assume that she can forever be excluded from free world sources of minerals supply.

This prospect gives added point to two challenging questions. How long will the world's mineral resources last, and by what machinery are those metals in short supply best distributed ?

As regards the first of these the position has to be faced that the world's mineral resources are a finite quantity even though their full extent is not as yet known. Sooner or later they must therefore become exhausted — more rapidly by the extent to which the rate of consumption expands and less rapidly by the rate at which new deposits are discovered. While the emphasis on prospecting must be paramount, there are a number of directions in which we can work to conserve what we have. Of these, the exploitation of increasingly low-grade or complex ores is solely in the province of the mining industry and here the problem is so to improve mining and beneficiation methods as to render large sub-economic deposits workable.

Primarily the problems involved are technical, and there is a pressing need for long range fundamental research into all prospecting, mining and extractive processes. The problem is, however, also one of management and there, although the example of Britain's coal mines may be the one which comes most readily to mind, it would seem that all over the world and in varying degrees there are still great economies to be achieved—from better design, (both of mine layout and of equipment), from better training (both of miners and of supervisory staff), from better utilization of men and machines, from better systems for the communication of orders and reports throughout the organization, from better labour relations and above all from clearer definitions of functions and accountability among senior mine officials and from greater delegation of authority and responsibility by them to competent and if necessary specially trained subordinates.

It is, of course, not only the mining industry which has a vital part to play in the battle against depletion, although we can do no more here than point to some of the broad headings — intensified efforts at scrap recovery, the battle against corrosion, and research into substitutes.

If we assume the eventual super-imposition of the Iron Curtain countries' mineral deficiencies on existing free world requirements, it is obvious that sooner or later we must expect crises in supply. It is of course very possible that events won't turn out quite in this way, and that instead Russia may carve out larger spheres of influence throughout Asia and the Middle East, and may even extend her grip on Europe. This, however, would not change the essence of the problem as, instead of consumer demands on free world resources becoming much increased, the free world would be denied, or at best would have to share, supplies from important producing areas which at present contribute little or nothing to Russian requirements. Thus either way there is likely to be an increasing tightness of supply and it is therefore none too soon to consider the kind of marketing machinery best fitted to conditions of chronic shortage.

Broadly there are but two practicable alternatives — rigid control and allocation or the unrestricted operation of the price mechanism. Any compromise between the two means either that the price mechanism is unable to do its work effectively or that controls become open to serious abuse. And yet the markets for most metals lie today somewhere within this area of compromise.

Whereas twenty years ago price fixing in the mining industry was designed to keep prices up, today it is in the main designed to keep prices down out of fear of competition from substitutes — actual or potential; but although the emphasis has now changed, essentially such price fixing still reflects a slump mentality. Nevertheless, if our view of the future is broadly correct and if more or less chronic shortage is to become the norm, then substitution will cease to be a threat to the producer and will instead help to relieve him from the pressures of consumer demands. Price fixing will thus cease to serve a useful purpose and indeed the producer will welcome the functioning of the free market as a regulator of demand. Not only will a higher price discourage use of the scarcer metals but, as we are now witnessing all over the world, it can stimulate, as can nothing else, the search both for new deposits and for substitutes.

There will, of course, always remain the small minority of metals either in critically short supply (nickel is one) or in chronic over-production (such as tin) where special action may be necessary. In the former case, rigid allocation would seem to be the only practicable weapon (and here the experiences of the late International Materials Conference provide a salutary warning against the consequences of half-hearted co-operation), while in the latter, a flexible quota scheme such as that envisaged in the International Tin Agreement probably still offers the best hope.

The prospect of ever increasing demand for metals provides the Commonwealth, or at all events those portions which are within the sterling area, both with the need for securing its own requirements from within itself and with a major opportunity — through expanded mineral exports — for redressing its balance of payments. Moreover, for many of the undeveloped areas of the Commonwealth it is the profits from mining which, whether ploughed back by private investment or drawn off by tax, are providing and will increasingly provide the basis for the industrizaliation and higher living standards of these areas. Consequently not only must Commonwealth mineral production be greatly expanded, but we must know with fair accuracy the prospective consumption requirements of the Commonwealth before we can assess probable export availabilities. Moreover, if the Commonwealth is to secure full economic benefit from the development of its mineral resources, we must ensure that the control of the new deposits to be opened up remains within the Commonwealth.

The fiscal pre-requisites for ensuring this are paramount and are, of course, fully familiar to readers of *The Mining Journal*. However thankful we may feel that more enlightened tax policies in other parts of the Commonwealth are preventing mining from grinding to a halt, the fact remains that if new mining finance on any large scale is to be found within the Commonwealth, it must come primarily through London, and there is but little hope of this so long as Whitehall persists in failing to recognize the unique circumstances of the mining industry and its importance to our future economic stability.

The rapid development of the Commonwealth's mineral resources calls not only for a healthy fiscal climate, it calls also for much closer co-ordination of information and of effort. Not only do we lack adequate statistical equipment for providing approximate, but up-to-date, world production, consumption and stock figures and trends. Further matters of high urgency are the compilation of available geological data (the making as it were of a Commonwealth minerals audit), the advancement and dissemination of mining and of metallurgical know-how, and the recruitment and training of personnel.

Co-ordination in such matters on a Commonwealth scale must be conducted at government level. Moreover the experience of such agencies as the U.S. Bureau of Mines and the Department of Mines in Canada suggests that this form of State intervention is helpful to the industry while in no way incompatible with the workings of free enterprise.

However, not only do the City and Whitehall have active parts to play in developing the mineral resources of the Commonwealth. A major role awaits Britain's mining machinery manufacturers. We in this country have the know-how and, in part at least, the productive capacity to act as the machine shop for overseas mining everywhere. The potential exchange earnings from these large prospective markets are great, but unfortunately we have no monopoly either in know-how or productive capacity, while the indications are that in sales organization and initiative, and in after sales service, we are often bested by our overseas competitors. Delivery dates are too often uncompetitive, and here we come back to the tremendous demands which the National Coal Board is making and clearly intends increasingly to make on the mining machinery industry's capacity. A major export industry cannot be built up on the fluctuating surplus capacity left over from the N.C.B.'s requirements, and — unless capacity is deliberately reserved or created for this export market — we shall never hold our own in this field. In the last analysis, this probably comes back to a matter of incentives, which — for many British mining machinery manufacturers with a strong home market — are singularly absent.

Thus once again we are faced with a problem of government. No regular reader of *The Mining Journal* could think that we are in any way advocates of unnecessary government intervention, yet the problems which we have been considering in these last few paragraphs, by their nature, can only be solved with some measure of co-ordination and a complete revolution in attitude both towards the taxation of the mining industry in particular and towards export industries in general. These matters rest with government and there we must leave them — not, we must confess, without misgivings.

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Gold By R. BRUCE DUNFIELD

THE re-opening of the London Bullion Market in March, 1954, brought respectability and status to the free gold market. With the Bank of England acting as the chief stabiliser of prices and with the London dealers operating on an extremely narrow spread of prices, the London market functioned smoothly and efficiently in 1955. It was only natural therefore that with speculation discouraged, fluctuations reduced and, fortuitously in this context, hoarding in 1955 being on a relatively small scale, the bullion market dealt almost entirely with central banking institutions. However dull and uninteresting the combination of these circumstances contrived to make the market, the result has been to widen the scope for trading in gold.

The re-opening of the London Bullion Market should not, of course, be regarded as the sole point of departure from which to describe the means by which gold has come to enjoy greater freedom. The International Monetary Fund and the European Payments Union provide admirable precedents where the financing of international trade by an extension of credit facilities has only been possible because the whole operation is based on gold. Indeed the success achieved in these fields has been the paramount influence in according a wider freedom for dealing in gold.

WORLD GOLD PRODUCTION
Excluding U.S.S.R.
(In thousands of f.oz.)

	1953	1954	1955
Union of S. Africa	11,941	13,237	**14,591**
Canada	4,069	4,366	**4,545**
U.S.A.	1,970	1,859	**1,891**
Australia	1,075	1,118	**1,055**
Gold Coast	731	787	**687**
Southern Rhodesia	501	536	**525**
Philippines	481	416	**415***
Mexico	483	396	**380***
Colombia	437	377	**381**
Congo	371	365	**375**
Japan	258	300	**289**
India	223	241	**212**
Elsewhere	1,924	1,852	**1,804***
World Total	24,464	25,850	**27,150***

* Estimated
(Source: Union Corporation)

Returning Confidence in Gold

On January 2, 1956, Belgium re-opened her Brussels gold market thereby establishing the means by which gold arbitrage operations in Europe can be re-established. Ten days later the Greek Government legalized the importation of gold in any form. Other important events pointing to increased freedom for gold dealings include Holland's agreement to ease transit regulations and further, it has been suggested that the Dutch will soon liberalise trading in gold. The same persistent rumour has been heard from Western Germany where trading in gold coins last year reached record proportions. In France dealings on the free market were carried out in a most liberal manner to the advantage of the Government. On the other side of the Atlantic in March last the Canadian Government removed all restrictions on the sale and export of gold. Moreover, the minting of gold coins for general circulation within a year is under consideration. Meanwhile in the United States dealings in U.S. and other gold coins have been increasing considerably, trade being classified as numismatistic. Further south in Latin America gold has been freed from all obstacles in Argentina and this situation may well spread to other South American Republics.

Although gold trading in free markets during 1955 has been estimated by Franz Pick to have risen by 18 per cent over 1954 and to have obtained the highest turnover in six years, it should be stressed that this is not necessarily a sign that the yellow metal is staging a comeback to resume its former predominant position in national monetary systems. It does, however, forcibly indicate returning confidence in gold rather than in paper currencies. In a more practical context it clearly points to the increasing need for gold to assist in the smooth functioning and financing of international trade.

This would explain why countries such as Belgium, Finland, Germany, Italy, Portugal, Sweden and Switzerland hold larger gold reserves now than they held before the war, which is particularly significant as unusually high interest rates can be obtained. Yet the broader picture showing the world's gold reserves (excluding those of the Soviet bloc) in relation to the value of world trade reveals a sharp decline in gold reserves expressed as a percentage of the value of world trade. Thus with the dollar a scarce currency, only by increasing the price of gold can the continual expansion of international trade on a fully multilateral and credit-free basis be financed.

South Africa's Record Gold Production

South Africa, the world's largest gold producer, attained a new high record output in 1955 of 14,602,267 oz., which comfortably exceeded the Union's previous peak performance of 14,406,761 oz. achieved in 1941. The South African industry has been able to expand its production because of the relatively new high-grade large tonnage mines which have recently come into production in the Orange Free State, the Klerksdorp district, and in the Far West Rand. The yield of gold from these new mines has more than offset diminished output of the older established companies on the Rand, some of which have been able to continue profitable mining operations only because of the production of uranium as a by-product. Winkelhaak Mines, the first new gold mining company to be established in the new gold fields in the Bethal area some 60 miles east of Johannesburg, is making good progress with the sinking of two small vertical shafts and two ancillary ventilation winzes from the surface. Apart from Winkelhaak, two further mines in the Bethal area may be established if present indications are confirmed by further drilling.

Other Major Producing Countries

Output from the Canadian gold industry also rose last year chiefly due to the levelling out of the exchange rate differential with the United States, which has given the Canadian gold mining companies approximately 35 dollars per fine oz. for the first time since early in 1952. Nevertheless, Federal Aid to gold mines under the Emergency Gold Mining Assistance Act is to be extended to the end of 1958 at the existing level. The present position in Canada is that all except two of the country's established gold mines receive the subsidy which is based on a formula intended to relate production costs to the fixed price of gold. Australian output last year was more or less held at the level of that reached in 1954, which was the highest recorded in twelve years. The position in the Gold Coast deteriorated somewhat owing to difficult labour conditions and penal taxation laws, which resulted in the closure of one mine. Nor is the outlook for an improvement in the position looked for during 1956 because of the general strike of African labour on November 20, 1955 which resulted in a stoppage of work at all gold mines in the Colony as well as the bauxite and diamond mines. This strike ended on February 27, 1956, when the men returned to work on the same conditions as had obtained before the strike. Thus, the possibility of further rumblings on the labour front in the months ahead must be considered a possibility. The gold mining industry in the United

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States, however, has not made any significant progress although production last year registered a slight increase.

Accurate production figures for Russia are still beyond the grasp of the statistician. Estimates continue to vary between an annual production figure of 2,000,000 oz. attributed to the U.S.S.R. as a "notional" figure by Union Corporation and 9,000,000 oz. by the U.S. Bureau of Mines, which is served by a minerals attache in Moscow. While most observers would place the Soviet's output of gold as somewhere between 4,000,000 and 5,000,000 oz. the United States figure may possibly have a political content in that the United States Treasury has always maintained, on the question of an increase in the gold price, that the automatic windfall that would follow such a step would accrue to those countries with the largest gold stock. In 1954 Russia provided a good deal of the interest in the gold bullion market because of her large shipments of the metal to the U.K. and other parts of Europe in exchange for sterling and dollars to finance her imports. While no precise figures are available for 1955, transactions involving the sale of Russian gold on the London market have been few, the bulk of London's supplies coming from South Africa.

The Price of Gold

By Dr. W. J. BUSSCHAU

THE individual studies of the metals other than gold contained in this *Review* show a record of production, in which both costs and the price of the metals chaneg with the fluctuations in demand and supply which in turn are modified by prevailing monetary factors. To the gold producers, however, another year has brought the disappointing experience of costs moving upward against a practically rigid price.

The figures of gold production for South Africa show the effect of the rising output from the mines in the new fields outside the old Witwatersrand, and while the total shows an increase, the effect is to mask the fact that a substantial portion of the production comes from mines working with a slender margin of profit and that a further rise in the ratio of costs to price will threaten the continuance of a substantial proportion of the current production. If some of the older producers were to cease production some relief might be afforded to the survivors, but unpleasant effects would be experienced in the localities in which the hard-pressed mines now operate, and such action would be short-sighted if a more favourable adjustment in the cost/price relationship were to come in the not too remote future.

The Depreciation of Gold

The average declared price for gold sold through the Transvaal and Orange Free State Chamber of Mines in 1955 was 250s. 3¼d. as compared with 248s. 9d. in the previous year. While the price of gold was therefore almost unchanged, the prices of important base metals like copper, tin, zinc and lead all ended the year 1955 with prices substantially higher than at the beginning. Of these metals copper showed the largest increase in price, and if the value of gold were to be expressed in terms of copper the effect was roughly that the amount of gold which could command 5 units of copper at the beginning of the year could at the end of the year be exchanged for only 4 units of copper.

The producer of gold is interested not so much in the price of gold expressed in money but in that price in relation to his costs in money. Expressed differently, the changing profitability of his current mining largely depends on the price of gold in terms of other commodities. In terms of this measure the year 1955 witnessed a further decline in profitability, but the rate of decline as compared with that in 1954 was probably less in all the main producing countries. At the turn of the year the gold producer would no doubt have feared that the year 1956, at any rate the earlier part, would see further increases in his working costs as these would include artifacts reflecting in their costs the 1955 increases in the prices of materials, like the base metals.

The Behaviour of Sterling

While he could expect this "lag effect," the producer might reasonably have felt that perhaps 1956, if it did not bring new hope, might at least mean a further slowing down in the rate of decline in profitability. This feeling of what might be called "declining despair," as affecting the Commonwealth producers, arises out of the behaviour of sterling.

Over the first half of 1955 there seemed to be a false sense of confidence in sterling with the cry of "Invest in Success" fading into the background, but in the second half the facts became clearer, and a new cry of "Deflation" was beginning to become audible. The facts relating to sterling are simple enough. Apart from the Government's external debt of over £2,000,000,000 the United Kingdom at June 30, 1955, had sterling liabilities to countries and international bodies of well over £4,000,000,000, against which it then held less than £1,000,000,000 of gold and dollar reserves and overseas investment (with a nominal value of £200,000,000). This would seem to be a very difficult position, but the position is even worse when it is appreciated (i) that the "cash" item of under £1,000,000,000 was held for the sterling area as a whole and not solely on United Kingdom account and (ii) that it fell by £200,000,000 to under £800,000,000 at the end of 1955.

In Mr. Butler's words: "Two world wars have turned us from being the world's greatest creditor to being the world's greatest debtor" and he might have added that the Cold War period has contributed substantially to the expansion of paper money. In the course of history devaluations have usually meant a downward readjustment of paper money in terms of gold but they have not usually been a signal for a fresh bout of inflation. To the Commonwealth gold producers the 1949 devaluations meant an appreciable increase in the price of gold expressed in terms of the other commodities but the Cold War inflation has meant a continuous depreciation of this value until at the turn of the year it stood at approximately where it was before devaluation. The gold producers in the United States did not have even this temporary easement and to them the "real" price of gold is only about half of what it was before World War II commenced.

The Chances of Devaluation or of a Straight Price Increase

At the time of writing, Mr. Macmillan's bold efforts are showing some results and he might, with further fiscal measures, be able to stem the rise in prices. He may, however, find that the weapon of deflation will not take him far enough to restore proper confidence in sterling and although talk of devaluation is frowned upon in the United Kingdom the result might well be that both deflation and some form of devaluation will have to be applied. It should be remembered too that at the last annual meeting of the International Monetary Fund Mr. Butler, as the then Chancellor of the Exchequer, gave open support to the proposition of an all-round increase in the price of gold and since then there has been interesting comment on the proposition in the United States. United States official opinion is apparently still set against such action but for the gold producers who can survive, this proper relief may not be as far distant as some pessimists believe.

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Silver By R. BRUCE DUNFIELD

SOMETHING more than a cursory glance at the production and consumption figures for silver in 1955 is required if the fundamental changes in the international silver markets which occurred during the year are to be fully understood. Indeed, the key statistics are those showing the free stocks of silver at the U.S. Treasury and the total reserves available to the Bank of Mexico at the end of 1954.

Effect of Stock Position on Prices

At the beginning of that year free stocks at the U.S. Treasury amounted to a mere 13,700,000 oz. compared with 49,600,000 oz. a year earlier. It was, therefore, quite obvious that if the rate of withdrawal during 1955 continued at anything like the rate in the previous year stocks would soon be exhausted. Nor was the position of the Bank of Mexico very strong, available reserves of silver totalling no more than 35,000,000 oz. If these figures gave any cause for alarm none was shown and informed market opinion in the United States at the end of 1954 looked for continued stability during 1955.

On the face of it this prediction seemed reasonable. The silver price on the New York market had remained unchanged at 85¼c. per oz. since January 16, 1953; Saudi Arabia had not minted silver coins since 1952; U.S. coinage commitments were known to be small as a major portion of the 52,300,000 oz. consumed at the Mints during 1954 for the production of subsidiary coinage had not been put into circulation; and finally, there was no reason to believe that supplies would not be forthcoming through the usual channels at much the same level as in 1954.

PRINCIPAL PRODUCERS
Excluding U.S.S.R.
(in millions of f.oz.)

	1953	1954	1955
Mexico	47.9	39.9	**45.0**
U.S.A.	37.7	36.6	**36.7**
Canada	28.3	31.2	**27.9**
Peru	17.5	19.9	**20.0***
Australia	12.5	13.8	**14.0†**

* Estimated
† Provisional

In the event, however, Saudi Arabia came back into the market early in 1955 and purchased 17,200,000 oz. from the Bank of Mexico for coinage purposes. This order was followed by Western Germany calling for 1,500,000 oz. a month. Coming as they did at a time when New York was making increased demands for supplies to meet trade requirements these contractual obligations proved too much for the Bank of Mexico and on March 11, it withdrew from the market stating that its reserves had fallen to 11,000,000 oz. and that the remaining supplies were committed. The impact of Mexico's action on the London and New York markets was immediate. In fact, New York, cut off from its regular source of supplies, low in stocks, and unable, by law, to export her domestically mined silver to satisfy the brisk demand from London and Western Germany advanced the quotation by 4½c. to 89½c. per oz. on March 15, the first price change recorded in twenty-six months. London actually anticipated the price rise by advancing its quotation 1s. 4d. to 74½d. on March 10 and followed the New York change by raising the price on the next two market days to 75½d. on March 15. The silver market remained firm throughout the remainder of the year, the peak price for 1955 and indeed for 35 years being reached on October 11 in New York and on the following day in London when the published price was hoisted to 92c. and 80¼d. respectively.

Subsequently, demand abated somewhat and the quotation in New York and London fell back and finished the year at 90½c. and 78½d. respectively. During this period the London price followed closely the U.S. quotation, although usually remaining slightly below parity point, an achievement made possible by the action of the Bank of England fulfilling in a small way the Bank of Mexico's role by supplying the market with silver for short periods to keep the price stable.

Meanwhile, the Netherlands Government shipped 18,200,000 oz. against their lend-lease account, of which about 12,200,000 oz. were credited to Treasury free stocks together with 11,000,000 oz. remitted in 1954 but not credited to free stocks. Thus although sales from Treasury free stocks were high in 1955, reserves at the year-end stood at 24,900,000 oz.

Repayment of Lease Lend Silver

In April, 1957, lend-lease silver is due for repayment and at the end of 1955 some 387,000,000 oz. were outstanding, the total being shared as between India and Pakistan, with 226,000,000 oz., United Kingdom 88,100,000 oz., the Netherlands (excluding 6,000,000 oz. already sent to the U.S. but not yet credited) 33,500,000 oz., Saudi Arabia 22,300,000 oz., Australia 11,800,000 oz., Ethiopia 5,400,000 oz., Fiji Islands 200,000 oz. No difficulty is envisaged concerning the repayment. Official figures are not available but it is believed that the United Kingdom and India have enough silver to meet their obligations. In any event, India has an extension of two years applying to the repayment of 100,000,000 oz. and the same arrangement applies to the debts of Ethiopia and Saudi Arabia.

Silver's Dual Role

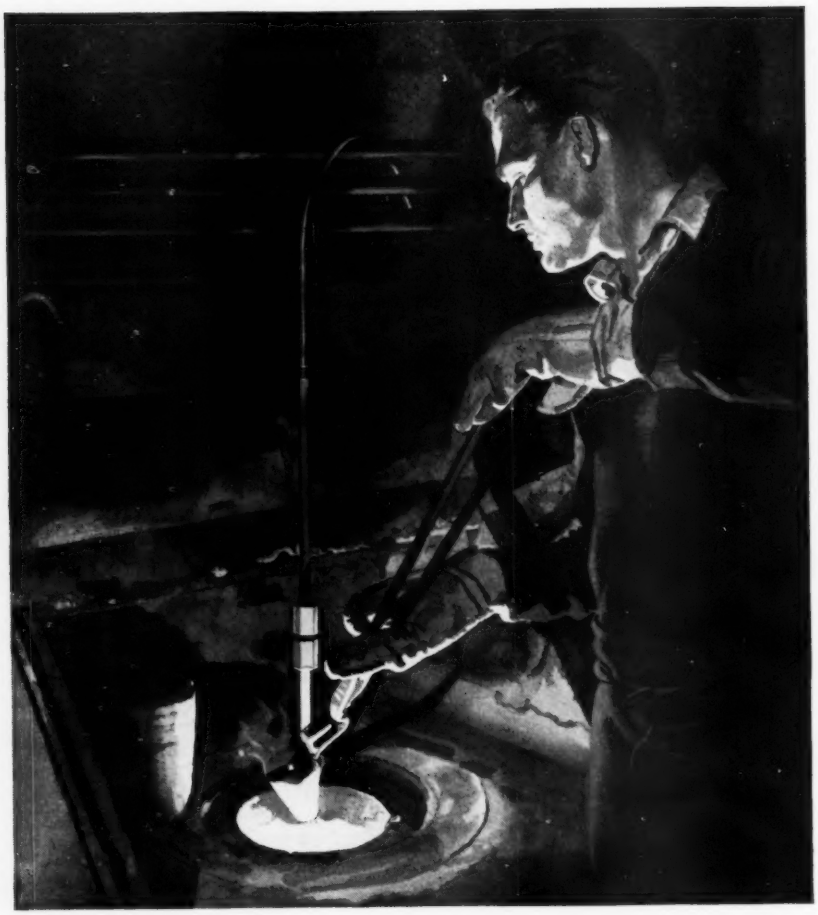
The difficulty of assessing the outlook for silver in any general market context stems from the dual role of the white metal, one side of which answers to its use as money and the other, to its use as a commodity for industrial and strategic purposes. The supply position is also obscure as approximately 80 per cent of the world's silver is obtained as a by-product of base metal mining. And to make matters worse silver production figures are not always published.

However, it is fairly safe to say that without the stabilizing influence of the Bank of Mexico the price of silver will be determined by the policies of the U.S. Treasury. These in turn may be vitally affected if the now famous Bill S.1427 becomes law. If this eventuates the U.S. Treasury would be freed from its present obligation to buy domestically mined silver at 90½c. per oz. and would have no authority to sell silver to industry except at the monetary rate of $1.29 c. per oz. Thus the silver price would, in large measure, be determined solely by economic rather than political factors.

Prospect of Expanding Supply and Demand

In any event, with the generally acknowledged bright outlook forecast for copper, and so long as the U.S. Government continues to stockpile lead and zinc, world silver production should be at least equal to that achieved last year of 203,700,000 oz. Consumption in the arts and industries, which last year totalled 179,100,000 oz. compared with 152,100,000 oz. in 1954, should rise further as industrial demand—particularly from the electric and electronic fields—continues to expand. Consumption for coinage purposes fell last year to 38,300,000 oz. compared with 66,400,000 oz. in 1954 giving a total absorption of silver last year of 217,400,000 oz. or 1,100,000 oz. less than in the preceding year.

However, the growing interest in minting gold coins for general circulation may well have favourable repercussions and lead to a return to the minting of real silver coins instead of the present tendency to issue "silver equivalents" of little intrinsic value.



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The Platinum Metals

DURING the past twelve months both the demand and the supply situations for the platinum metals have been much under discussion. Early in 1955 there was a slight decline in demand, accompanied by a weakening in the price. During the latter half of that year and the earlier months of 1956, while there was no change in the nature of the demand for platinum, there was a general and fairly marked increase in requirements from practically every type of consumer. Output, although showing an increase in the case of South African supplies, could not keep pace with this strong demand, and with Russian supplies apparently no longer on offer, a pronounced shortage developed.

In November the official U.K. price of platinum rose to £32 10s. per oz., while in February a further advance was made to £34 per oz. These figures compare with free market quotations (for the relatively small amounts of platinum changing hands) of around £42 per oz.

Preliminary blast furnace treatment of South African platinum bearing material in the Brimsdown refinery of Johnson, Matthey and Co. Ltd.

Increased South African Output

Early in the present year, with this strong demand in front of them, the South African producers, Rustenburg Platinum Mines, announced a major expansion programme. Since about 1953 Rustenburg has been the largest individual platinum producer in the world, and it is now proposed to step up production by a further 50 per cent over the 1955 output. Expansion is planned at both the Rustenburg and the Union sections, the increase in the latter case being only 25 per cent, with the major portion of the increased production coming from the Rustenburg section. At both sections it is stated that the mines themselves are in a position to provide the additional tonnage, although further shaft sinking will commence within the next twelve months to provide for future requirements. The reduction works and the concentrate smelting plant will be expanded, and Matte Smelters Ltd.—jointly owned by Rustenburg Platinum Mines and Johnson, Matthey & Co. Ltd.—are also to increase the capacity at their plant. Some of the additional platinum produced at the mines during the early months of 1956 will have been refined and will be available for sale towards the end of this year, while the full rate of output of refined metal should, so far as can at present be seen, be reached early in 1957.

Future Demand

Accurate and reliable output figures for the platinum metals are notoriously difficult to obtain, but it appears that African production, which has been around 300,000 oz. for the group, will advance to some 450,000 oz., of which something approaching 300,000 oz. will comprise platinum itself. Canadian production, running at some 350,000 oz. of platinum group metals, but only around 160,000 oz. of platinum, appears to be steadily maintained, with no appreciable increase to be expected.

The popularity of platinum and platinum group metals stems from their high resistivity to corrosion, extreme temperatures and spark erosion, combined with good mechanical qualities and catalyst action.

Essentially the firmness of demand for platinum is attributable to the oil, steel, glass and chemical industries, although telephone and electronic apparatus are still responsible for an appreciable volume.

The demand for motor spirit with a higher anti-knock rating than can be obtained by the normal refining method of fractional distillation combined with catalytic cracking has led to the development of catalytic reforming processes. These are carried out by passing a suitable petroleum fraction together with hydrogen through beds of solid catalyst at high temperature and pressure, when by molecular re-arrangement the anti-knock rating of the product is considerably improved. Most of the successful catalytic reforming processes introduced to the petroleum refining industry employ a platinum-containing catalyst, and the extensive programme of construction now under way will absorb very large amounts of platinum for a number of years.

In the steel industry the use of the platinum : rhodium-platinum thermocouple as a means of temperature measurement in the open-hearth furnace grows steadily with increasing steel production.

Almost the whole of the world output of nitric acid is produced by the oxidation of ammonia at a rhodium-platinum alloy catalyst, generally consisting of a number of large gauzes, up to 8 or 9 ft. in diameter.

Other Growing Uses

Greatly increased quantities of platinum are now being absorbed in equipment for the handling of molten glass. Certain special types of glass, which must be free from any contamination, are made in large platinum vessels, while in the production of glass fibre the electrically heated trough-shaped furnaces are made from heavy platinum sheet.

In certain industrial electrochemical processes such as the manufacture of hydrogen peroxide and of persulphates, the electrodes are normally made of platinum or of platinum clad copper, and the greatly expanded production of these materials is also absorbing much increased amounts of platinum.

All these major uses of platinum are in one way or another essential to present-day industry, and there is little doubt that a tight supply situation lies ahead for some considerable time, even discounting the greater output envisaged from South Africa.

Russia still remains an unknown quantity in the international supply position. Last year the U.S.S.R. disposed of an estimated 250,000 oz. in Europe, but it remains to be seen how in due course future Soviet sales will affect market conditions.

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Copper

By URSEL BALIOL SCOTT

CONTRARY to all expectations, the pressure on copper prices increased still further during 1955 (see chart, page 25) and indeed the upward pressure has continued into the first quarter of 1956 and was only finally arrested at the beginning of April by the reluctant decision of the American owned Chilean mines to price their sales to the States at the L.M.E. price. On only one day during 1954 had cash copper gone above £300, yet after the first fortnight of January 1955, it was never again below that figure while on September 7 and again in December it briefly topped the £400 mark, since when it has, of course, gone considerably higher.

The really astonishing thing about this rise (the average cash price in 1954 was £249 and in 1955 £352) is that it occurred side by side with an increase in world production of at least 200,000 tons (notwithstanding three major strikes) and with a net decrease in U.S. and U.K. stockpile offtake of about 150,000 tons. The commercial consumer thus absorbed over 350,000 tons more than in 1954 and was still asking for more, while at the same time turning to substitutes wherever practicable.

MINE OUTPUT OF PRINCIPAL COUNTRIES

(in thousands of l.tons)

	1953	1954	**1955**
United States..	826	745	**887**
N. Rhodesia ..	367	392	**353**
Chile	363	364	**435**
Canada	225	268	**290**
Belgian Congo	211	222	**235**(e)

(e) Estimated.

Production

Total free world production can only be estimated, but it seems probable that this rose by at least 200,000 tons to around 2,650,000 (see table). This increase occurred despite heavy production losses of at least 140,000 tons due to major strikes on the Copperbelt, in the U.S. and in Chile.

The U.S. provided the largest single increase with a domestic mine production 19 per cent up at 887,000 tons, a figure which would have exceeded 950,000 but for a virtually industry-wide stoppage which lost U.S. producers some 75,000 tons during July and August, a period when demand was already high and stocks low. That the effects of this stoppage were not more seriously felt — although in any case they were bad enough — was due to the fact that July was a vacation period for many users and that the August hurricane and floods put a large section of the brass industry out of action for some two or three weeks.

Curiously enough one large new mine — the San Manuel (with a scheduled capacity of 70 000 tons per annum) — started to produce during the year and the bulk of the increase came from growing output at mines (such as White Pine) which were started up in 1953 and 1954 (in the main under the government support price programme) for what were at then prices, in danger of being sub-marginal propositions. Incidentally, it should not be forgotten that 1954 was far from being a peak production year in the States. Not only were 40,000 tons lost through strikes but a similar amount was also lost early in the year through voluntary production cutbacks in the face of what U.S. producers then believed (erroneously as events subsequently showed) to be an overloaded market.

On the Copperbelt a two months strike at the beginning of the year, resulting in a production loss of 50,000 tons, cost Northern Rhodesia her place as the world's second largest producer, and in consequence that country alone amongst major producers recorded a reduction in output amounting to some 40,000 tons (see also page 157 *et seq.*, and pages 284 to 289).

Chile, on the other hand, suffered somewhat less acutely than usual from disputes, and lost only 15,000 tons from this through a stoppage which began in mid-December and continued through into January. Moreover, the voluntary cutback in production which paralleled that in the States at the beginning of 1954 and which may have cost the industry 10,000 tons in that year was, of course, not repeated in 1955. Even so, Chile's output of 435,000 tons is a very considerable advance on recent years and there is reason to hope that the introduction of the new Copper Laws last year will generate much more enthusiasm for increased investment in an expansion of the industry (see also page 203).

Canadian production has been going steadily ahead over the past three years. The big Gaste mine belonging to Noranda came into production last year although it was not possible for full rated capacity to be reached.

Consumption

Free world consumption of new metal totalled about 2,800,000 tons, a 10 per cent increase over 1954, which was itself an all time record. This increase was made possible mainly by the above-mentioned 200,000 ton rise in production. There was also a net decrease of 150,000 tons in stockpile offtake compared with 1954. (U.S. stockpile offtake in 1955 was probably between 40,000 and 50,000 tons against 140,000 tons in 1954, while beginning in April the U.K. Government released some 65,000 tons over the rest of the year). This, however, was less of a factor than appears at first sight as refiners' stocks remained substantially unchanged during 1955 at 200,000 tons, whereas over the preceding year they had declined by about 125,000 tons.

The pattern of consumption during 1954 had been one of greatly expanded usage in countries other than the U.S.A. (mainly in Continental Europe and the U.K.) where consumption had risen by 400,000 tons, and had entirely extinguished the simultaneous decline of 210,000 tons in U.S. consumption. The feature of 1955 was that this great advance in consumption outside the States was not only sustained, but actually increased by about another 50,000 tons over 1954, while at the same time the past year has seen U.S. consumption regain practically all the ground lost the previous year and no doubt even more copper would have been consumed — and much more stocked — had it been available.

Indeed, the unsatisfied appetite for copper in the States underlines the notable and novel characteristic of the market during 1955 and since — namely that in a consistently tight market, copper was throughout the year more readily available in London and on the Continent than it was in the States. Broadly speaking, the cause of this lay in the U.S. producers' extreme reluctance to raise the price either of their domestic output or at which they would import from their Chilean properties. How far this reluctance was motivated, at least during the first half of the year, by a desire to hold prices down in anticipation of forthcoming wage negotiations and how far these negotiations might have been eased had they not done so, can only be conjectured.

Pricing Policies

The fear of copper pricing itself out of the market has been an abiding one among U.S. producers these past two years and more, and they have consequently been extremely

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reluctant to allow prices to rise. In fact, their prices have risen since January, 1955 by over 50 per cent, but they have been forced to each increase only in an attempt to close the gap between that quotation and the free market price as exemplified in the L.M.E. quotation. The pressure for these increases came primarily from the Chilean Government, which was reluctant to allow even the contractual amount of 35 per cent of Chilean output to be sold at the U.S. controlled price when much better prices were to be had in Europe.

The unreality of the U.S. producers' quotation was further underlined in September when the U.S. custom smelters officially broke away from the producers' price and established a level of their own which has since tended to follow the L.M.E. quotation without being directly linked to it. Even so, it was not until April, 1956 that the U.S. producers really faced up to the fact that, if they wanted to go on importing copper, they had to pay the going price, and accordingly agreed to sell all their Chilean production at L.M.E. prices. As some people had long been forecasting, this move aided by the Chancellor's credit squeeze at once began to take the pressure off L.M.E. prices which, by the end of April were some £85 below what they were at the time when U.S. producers took this decision (see also page 25).

It is arguable that had the U.S. producers decided on this policy a year ago, the fantastic prices which we have since been witnessing would never have been reached. So long as the American price was pegged, or was always being increased by stated amounts, it was possible for the free market to keep its price just sufficiently far ahead to ensure steady shipments to Europe. Once American importers were ready to follow the market, this ceased to be practicable, and the Chileans no longer had any interest in diverting copper from the American market.

Criticism of the L.M.E.

However, while London has perhaps been justified in the view that it is the American producers' abortive attempts at price fixing which have been forcing up the L.M.E. price, the L.M.E. quotation has, of course, itself come under fire from the exponents of fixed pricing on the grounds that the thinness of the L.M.E. market made its prices too volatile and, on a tight market, generally too high for the good of the industry. This, however, is to confuse cause and effect. The L.M.E. does not, indeed cannot, dictate prices. It merely determines the price at which marginal supplies and requirements can be equated at any given time. Neither before the war nor since has the L.M.E. been more than a marginal market, and the great bulk of production has always passed direct from producer to user without going through any sort of market. What, however, the L.M.E. has always done (aside from absorbing marginal surpluses or meeting marginal shortages and—with certain limitations in the post-war period due to heavy backwardations—providing hedging facilities) has been to provide a realistic basis on which to price the great bulk of copper transactions which never go through the market.

There is, of course, some truth in the criticism that under post-war conditions the L.M.E. price has been a hypersensitive barometer due to such factors as currency restrictions, reduced stockholding by consumers and certain defects in the post-war copper contract itself. Nevertheless, the biggest single factor in the thinness of the market has been the failure of producers to put more tonnage through the market, and to this extent the remedy for much of the criticism of L.M.E. prices lies in the producers' own hands. However convulsively, the past year has shown that, in periods of acute shortage, copper will tend to find its way to those centres which are most sensitive to market influences, and it is therefore to everyone's interest that the volume of business in such centres should be large enough to iron out the more extreme short-term fluctuations.

An Experiment in Price Stabilisation

As much as anything it was the undeniable volatility of the L.M.E. price which led the Rhodesian Selection Trust group to depart last May from the L.M.E. price as a basis for selling their output and to substitute a weighted average price arrived at by a computation of the average of the prices at which varying tonnages were changing hands. By its nature this purely historical price was dependent on others making the market as a basis for its computation. Originally, it was to operate for a minimum of 30 days before alteration, and as such could be said to provide some partial substitute for the hedging facilities on the L.M.E. which a persistent backwardation had been hampering. However, the ebullience of the market was such that this facility had to be discontinued and since September the R.S.T. price has been subject to alteration at 24 hours' notice. Even so, the R.S.T. price has persistently been below the L.M.E. price while the market was rising and it was only in April that the L.M.E. price began to be below that of the R.S.T. The real test of the R.S.T. policy will, of course, come on a falling market.

The Outlook

No new major producers are scheduled to start up this year, although several are on the way for 1957 or later. Even so, given freedom from strikes—admittedly a big assumption—production might easily be up this year by another 250,000 tons, *i.e.*, 140,000 tons lost last year through stoppages plus over 100,000 tons of increased production mainly from the States and Chile (say 50,000 tons each), and the Copperbelt (say 25,000 tons)

Looking further ahead, Mr. Prain, head of the Rhodesian Selection Trust group, has estimated recently that some 426,000 tons per annum of increased or new production would be coming on to the market by the end of 1957 from eighteen different mines, while an additional 160,000 tons would be available by the end of 1960. These figures suggest the possibility of about 550,000 tons or over 15 per cent more copper being available in 1958 than in 1955 and some 700,000 tons or nearly 25 per cent more in 1961 than in 1955. What are the prospects of absorbing this much copper and what is likely to be the position if market requirements do not add up to an increase of this magnitude?

The answer depends largely on two factors. The rate at which general industrial activity will continue to expand, and the price at which copper is going to be available. Past experience has shown a close relationship between copper consumption on the one hand and population trends and steel output on the other, and taking a line through the expectation for the two latter there is no reason why the next five years should not see a much increased copper demand, even assuming that stockpile requirements have been fully met in the interim.

This, however, does presuppose that price-wise copper will in the meanwhile considerably strengthen its competitive position and thus arrest the accelerating trend towards substitution. Practically the entire world's output of copper would remain economic at 30 c. and there is no doubt that at this price the inducement to turn to alternative materials would be considerably reduced—although not eliminated. Consequently, if, in the months ahead, supply were to appear to have caught up with (or even to have exceeded) demand, this might be no bad thing if in consequence prices could be brought down to somewhere between 30 c. and 35 c. The big risks seem to be that either Chile or the American producers may be unduly sensitive to price falls, as they were in similar circumstances three winters ago, and that either Chile will stage another sales strike in the face of declining revenue or that the Americans will again begin cutting back production before it becomes really necessary.

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Tin

By URSEL BALIOL SCOTT

FOR tin, the past year has been characterized by a sense of unreality induced by the interminable delays in the final ratification of the International Tin Agreement. That these delays have been possible without any dislocation to the market has been due to the United States' continued operation of the Texas smelter and to the continued stockpiling of metal from this source. From the producers' point of view, 1955 was a more satisfactory year than its predecessor, the average tin price being somewhat higher, while the physical surplus of production over consumption showed a welcome fall as compared with 1954, due to a further marked improvement in consumption.

Prices

During the first nine months of 1955 L.M.E. cash tin remained, with two brief exceptions, within the same £700-750 price range which had already characterized it continuously since April, 1954. During the last three months of the year a gradual price rise developed reaching a peak of £840 on December 14 (see pages 25 and 27). This progressive increase was the outcome of uncertainty as to the political outlook alike in Malaya and in the Middle East (always an important factor in communications) superimposed on an unusually heavy demand in the States where consumers found themselves in the autumn with low stocks and strong demand more especially in the case of tinplate and solder.

PRODUCTION AND CONSUMPTION
(000 tons)

Mine Production	1953	1954	1955
Malaya	56.3	60.7	**61.2**
Indonesia	33.8	35.9	**33.4**
Bolivia*	34.8	28.8	**27.9**
Belgian Congo	15.3	15.1	**15.2**
Thailand.....	10.1	9.8	**11.0 (e)**
Nigeria	8.2	7.9	**8.2**
Others†	10.3	8.8	**11.7 (e)**
Total	170.2	169.5	**168.6**
Consumption			
U.S.A.....	54.0	54.4	**60.0**
Untd. Kingdom	18.6	21.4	**22.4**
Others†	58.5	62.8	**67.0 (e)**
Total	131.1	138.6	**149.4**

* Exports. † Excluding U.S.S.R. and China. (e) Estimated.

Production

Free World production was again very slightly down on the previous year at 168,600 tons against 169,500 tons in 1954 (see table for details). Moreover, the world cannot even consume the tin it is producing. Thus, in the absence of renewed prospecting activity, the gradual decline in production is likely to continue, and must in any case be accelerated either in 1957 or in 1958 given the introduction of quotas under the I.T.A.

Once again last year's decline would have been more pronounced had it not been for the remarkably sustained strength of Malayan production, which was the highest recorded since before the Japanese occupation. Malaya's rising production in recent years has been remarkable in face of the oft-repeated warnings that workable reserves are rapidly becoming exhausted. In any event maintenance of high production must pre-suppose a continued freedom from strikes. The industry was in fact remarkably strike-free last year—unlike other branches of the economy—but labour relations were not easy, and it may well be that the progress towards self-government may be accompanied by growing labour unrest throughout the Federation, and possibly by renewed agitation by the unions for nationalization of the industry. (See also page 215).

Bolivian production has continued to decline, but not perhaps so rapidly as some of the more pessimistic reports might have led us to expect. Moreover, this decline has set in since Bolivia was allocated her quota percentage under the I.T.A., so that in the event of quotas being introduced her present level of output is likely to remain unaffected. A matter of major interest for Bolivia has continued to be the future of the Texas smelter, and the problem of where, in the event of its shutdown, to market the ten to twelve thousand tons at present absorbed there annually. Basically, this of course presents no problem as prior to World War II the entire Bolivian output (sometimes 20 per cent more than it is today) was treated in Europe and if necessary could be again. Over 50 per cent of Bolivia's output is already taken by the Williams Harvey smelter, which at the beginning of this year renewed its contract with the Corporacion Minera for a further five years. (See also page 199).

Indonesia's 7 per cent decline in output is presumably a reflection of that country's chaotic political situation, wherein the elementary necessity of maintaining law and order may well have been diverting the government's attention from maximizing the output of her major nationalized industry.

In the Congo, production was slightly in excess of 1954. However, despite the more satisfactory tin price, a number of small producers ceased production during the year, while even Géomines stopped working its hard pegmatites which were yielding a very small profit margin and are concentrating on the softer and more cheaply mined deposits. The fact that the Congo tin industry is not more resistant to price declines may in part be explained by the fact that much of her capital equipment was installed in the early post-war years, and consequently stands in at a higher book value than a great deal of the equipment in Eastern countries. Labour costs in the Congo are also higher owing to the relatively low productivity of about one-third of a ton per worker per year against 1½ tons in Malaya.

Among lesser producers the year has seen no significant changes although it is notable that Thailand's production continues to expand. Here is a country with a big potential for increased production which must be viewing the I.T.A. with mixed feelings, and the introduction of quotas might well arrest the trend, discernible in recent years, for Malayan companies to pay increasing attention to Thailand's tin resources as an offset to the dwindling reserves in Malaya itself.

Consumption

Consumption last year again recorded a sizeable advance, and at 149,400 tons reached the highest total for any post-war year, other than 1950 in which U.S. buying for stock was exceptionally heavy. This advance of nearly 11,000 tons over consumption in 1954 was accounted for mainly by a 5,600 tons increase in the U.S. (where consumption of secondary tin also rose by 3,000 tons), 1,500 tons in France, 1,300 tons in West Germany and 1,000 tons in the U.K. Other notable figures were those of Denmark where a consumption of 4,770 tons represents a fourfold increase over the past three years while by contrast the Netherlands total of 2,513 tons represents a decline of 70 per cent over the same period. These two sharp changes are largely attributable respectively to a growing and declining export trade in high-grade tin alloys, partly due to a dollar premium in the one case and to the decline in the discount on transferable sterling on the other.

Tin in Tinplate

The improved position in U.S. consumption owed practically nothing to the 16 per cent increase in tinplate production recorded there in 1955, as this only resulted in about a 1 per cent increase in tin consumption. During the year the production of electrolytic tinplate increased by over 30 per cent,

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while the production of hot-dipped decreased by 15 per cent and now constitutes less than one-fifth of total U.S. tinplate production, as compared with the U.K. where the total is 70 per cent and France where it is over 80 per cent. It thus appears that there can no longer be much scope in the States (which produces over 70 per cent of the world's tinplate) for further conservation of tin through transfer to electrolytic methods. In other parts of the world however economy through switching over from hot-dipped has still a long way to go, yet the rate at which the transfer has been going on throughout the world as a whole may be gauged from the fact that world tinplate production has risen by 40 per cent over the past three years while the amount of tin consumed has risen by less than 14 per cent. Even so, if the planned 20 per cent increase in U.S. and U.K. tinplate production over the next two years materializes, this alone could mean an annual increase of 7,000 to 8,000 tons in tin consumption.

Stock Position

During 1955 world stocks (excluding the U.S. stockpile) declined from 73,700 tons at the beginning of the year to 68,500 by the end of November. Thus some 5,000 tons must be added to the year's 19,200 tons excess of supply over consumption in order to arrive at the apparent offtake by the U.S. stockpile which would thus appear to have been around 24,000 tons. (The actual Texas smelter output for 1955 is reported at 22,329 tons). Price movements last autumn and since suggest that this offtake was on the large side for the equilibrium of the market.

The U.S. stockpile is believed to represent some six years U.S. consumption at current rate, which suggests reserves of upwards of 350,000 tons! Further acquisitions for this stockpile ceased, some years ago, to have any strategic significance, and latterly Washington has been stockpiling partly (in demonstration of her "benevolent neutrality") to support the market in the absence of the coming into operation of the I.T.A. and partly in order to keep the Texas smelter going as a matter of domestic political expediency.

The Outlook.

The mere fact that stockpiling has continued has, however, in itself been largely responsible for the delay in the implementation of the I.T.A., which still awaits Indonesia's final act of commitment. With Malaya habitually supplying over 70 per cent of U.S. commercial consumption, Indonesia obviously has a short-term interest in the continuation of the Texas smelter, which has been absorbing between a quarter and a third of her output, and it is perhaps understandable that she should have refrained from final ratification of the I.T.A. so long as the internal political situation in the U.S. made the continued operation of the smelter seem in any way likely.

If, as now seems probable, the Texas smelter is to remain in operation and stockpiling is to continue at the present rate at least until next January, Indonesia will presumably continue to procrastinate. However, there need be no automatic connection between continuing to operate the smelter and continuing to stockpile, and it may in any case prove to be neither politically expedient, nor in the interest of the market in the present condition of tight supply, to maintain last year's rate of stockpile offtake. Consequently if Washington were to decide either to sell the smelter output on the open market or to cut down output, this might prove to be the quickest way of securing Indonesia's ratification of the I.T.A.

Thus, as for so many years past, the last word on the outlook for tin seems still to rest with the United States—assuming always that political unrest in any of the main producing countries does not lead to an interruption of supplies.

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Lead

By J. A. DUNN

REFLECTING the general high level of the world's industrial activity throughout 1955, lead producers and consumers had a decidedly satisfactory year's throughput. To lead producers the steady maintenance of reasonably high prices was particularly acceptable.

World Position

Mines throughout the world responded to the stronger demand by increased production. Available production data from various sources are not consistent; the accompanying table has been revised for previous years according to the most reliable sources, and based on metal content of mine products, wherever available, rather than on recoverable content. For U.S.S.R., the production is estimated. The 1955 data are, of course, provisional. In 1954 Australia attained an output about equal to the leading producer, U.S.A., and preliminary figures suggest that this position continued through 1955.

MINE PRODUCTION
(000s long tons)

	1953	1954	1955
U.S.A.*	305	283	**298**
Australia	269	285	**293**
Mexico*	218	213	**209 (e)**
Canada*	173	196	**173**
Peru	112	108	**114 (e)**
Yugoslavia	84	83	**80**
French Morocco	79	81	**89**
Germany	62	66	**67**
U.S.S.R. (est.)	200	200	**200**
Others (est.)	340	385	**485**
World Total (est.)	1,850	1,900	**2,000**

* Estimated recoverable. (e) Estimated.

Total world consumption of lead was in excess of 2,000,000 l.tons, close to world output. Nearly 40 per cent of the world total was consumed in the United States. Although there was no real shortage of lead, demand was consistently strong. There was little room for accumulation of stocks, and such figures as are at present available indicate some overall reduction in them towards the end of the year.

Prices Steady

In the open market history of lead there have been few years in which prices have been so consistently steady as in 1955. The course of L.M.E. prices is shown on page 25. Throughout the year prompt metal stood at above £100, the year's average being £105 18s. 0d. Towards the end of November prices took a sharp upward turn reaching £120 by the end of the year—the peak price since open market trading was resumed on October 1, 1952. Apart from a small contango at the beginning of the year, and again in May, there was a persistent small backwardation ranging generally up to 10s. but occasionally up to £1.

The New York price opened the year at 15 c. per lb. and continued at this level until end of September when it rose to 15½ c.; it was raised to 16 c. on December 29. Although U.S. price support stockpiling policy undoubtedly was a main factor contributing to the general steadiness of price early in the year, consumption improved as the year progressed to such an extent that offers to the U.S. stockpile fell away, and the price latterly has been an index of real demand.

The Main Producing Countries

Although producers in the United States still considered the price to be inadequate, production there was at an improved level, broken only by a brief strike in June-July of mine, mill and smelter workers. Mine production was about 298,000 l.tons, about 15,000 tons higher than in 1954 and about 7,000 less than in 1953. Smelter production from foreign and domestic ores including some secondary metal was 450,000 tons, recovery of secondary metal was 10,000 tons higher than in 1954 at 446,000 tons while imports of refined metal were about 10,000 tons down at 238,000 tons. Smelters' stocks of refined pig lead at the end of the year were down to 20,500 tons (70,500 tons), while consumers' stocks were also slightly down at 103,000 tons (111,000 tons). Total consumption of primary and secondary lead was thus 950,000 tons (965,000 tons in 1954). The principal usages, for storage batteries and tetraethyl, greatly increased as a reflection of the automobile industry boom.

In Australia, mine production increased slightly to a further peak of about 290,000 tons. Mexican production increased with U.S. demand, but Canadian production was below that of 1954.

Europe

Demand was consistently strong in the United Kingdom throughout the year, prompt metal becoming, if anything, increasingly tight towards the close of the year. The dock strike, although it impeded supplies in May-June, had little effect on demand. Consumption reached an all-time peak of 371,000 tons (335,471 tons in 1954). There was a considerable increase in the main usage, cable making, to 109,000 tons (85,825 tons) and in tetraethyl lead, 21,770 tons (15,229 tons). Stocks tended to increase in the third quarter but were generally low and were decidedly short at the end of the year.

On the Continent, consumption and production continued for most of the year at about the 1954 level, but demand increased somewhat latterly.

Outlook

Whether the manufacturing spree of the past 18 months will continue throughout 1956 would seem doubtful in view of the credit restrictions which are coming increasingly into force in many countries. Perhaps by the time this appears in print it will become clearer whether the consumption curve will flatten or will turn down for a while.

The long-term trend of consumption is, of course, upward, and any recession from the 1955 peak would be only temporary. Production is also increasing. Although reserves in United States have been depleted with a consequent reduction in domestic output over recent years, they have been more than compensated by the development of new reserves in other countries. The general picture is that mine capacity plus secondary recovery is ahead of total real consumption, but the difference is so little at present that factors retarding the flow of metal, or any minor surge in demand create a tight supply. Thus, maintenance of the recent high level of lead prices should not be counted upon. On the other hand, no severe fall need be expected, at any rate over 1956, as, in view of the small intake in past months by the U.S. price support stockpile, should demand slacken the continuation of purchases for this stockpile seems certain.

Having regard to the large amount of lead absorbed by the automobile industry, for storage batteries and tetraethyl, the key to the near-by future of lead seems to be largely with continuation of a high level of automobile production, particularly in the United States, or with the U.S. policy of price maintenance.

During 1955, some proposal was made in Europe for the creation of an international Buffer Stock in support of prices, presumably to take the place of the U.S. price support policy. However, there is no apparent basis for such pessimism as would justify international Government action at present. On the other hand, producers cannot afford to relax their efforts to promote old, and find new, uses.

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Zinc By J. A. DUNN

AS with lead, consumers and producers of zinc had a year of peak activity in 1955. The gradual upward trend in prices over the year was a decided incentive to increased production and, from the point of view of consumers, was not out of line with increases in the price of other metals, particularly of aluminium. It is perhaps many years since the zinc industry has had such an unruffled period without any great disturbing influences on production, marketing or consumption. The most notable marketing feature was the consistent scarcity of high grade zinc for die-casting.

On the London Metal Exchange the zinc turnover for the year was 206,700 tons, compared with 194,825 tons in 1954.

World Position

Production of zinc in the United States has recovered part of its drop in 1954. Producers there still considered the 1955 price inadequate, but, so long as price remains at the present level, the decline in U.S. production seems to have been arrested. Mine output in most other producing countries continued to expand, so that the world total represented yet another record—there has been an unbroken sequence of these records since 1948. Outside of U.S.S.R. and Poland, mine production was of the order of 2,350,000 tons (2,270,000 tons in 1954) and refined zinc production was about 2,050,000 tons.

MINE PRODUCTION
(000's l.tons)

	1953	1954	1955
U.S.A. (a)	489	415	**450**
Canada (a)	356	336	**381**
Australia	239	253	**257**
Mexico	222	218	**269(e)**
Peru (a)	132	153	**170**
Belgian Congo	124	81	**85(e)**
Italy	103	116	**120**
W. Germany	114	119	**118**
Japan	94	107	**104**
Poland (est.)	150	150	**150**
U.S.S.R. (est.)	225	225	**225**
Others (est.)	350	475	**480**
World Total (est.)	2,600	2,650	**2,800**

(a) Estimated recoverable.
(e) Estimated.

Demand was in keeping with the high level of industrial activity. World consumption was about 2,500,000 tons, nearly 40 per cent being consumed in the U.S., as with lead. Heavy stocks, which were still held by producers and consumers at the beginning of the year, particularly in the United States, were greatly reduced. Throughout the year, notably in the last quarter, there was a consistent tightness in prompt metal.

Year of Steady Prices

Opening the year at £84 (current month) on the London Metal Exchange, the price of g.o.b. zinc rose to £91 by early February, then, apart from a brief drop to £85 at the end of February, held between £88 and £90 until May. Thereafter, except for a few days in August, it continued above £90, fluctuating up to around £93 until the end of November when a sharp rise took the price to £101¼ by the close of the year. This represented a peak price since open trading was resumed on January 2, 1953. The average price for the year was £90.7. With prompt metal in tight supply throughout the year there was an almost consistent backwardation ranging up to £3 at the end of the year, but there was a small contango in July-August and in mid-October. High purity zinc settled down to a consistent premium of £12 for several months, but very much higher premiums were paid at the year end.

In the United States, Prime Western opened the year at 11.5 c. per lb. East St. Louis, rising to 12 c. early in April, to 12½ c. in mid-June, and to 13 c. in early September, continuing at this rate until the end of the year despite some tentative attempts in mid-October to raise the price to 13½ c. However, the price was raised early in 1956, somewhat in line with the London price.

As with lead, apart from the earlier months when the U.S. stockpiling price support policy was a decided factor in maintenance of price, over most of the year the increased price has been a reflection of the upsurge in real consumption, and absorption into stockpile for price support purposes has been minor in amount.

Main Producers

Marginal producers in the U.S. responded to the rising prices throughout 1955, and the total production in that country improved to 448,000 tons (415,000 tons). Output of slab zinc from domestic and foreign ores totalled 925,000 tons (775,200 tons) including 64,000 tons of secondary metal. In addition some 80,000 tons went into the production of zinc oxide, lithopone and sulphate. Imports of slab zinc were 174,000 tons (140,000 tons), exports were 17,400 tons (22,300 tons). Refiners stocks were down to 37,000 tons (111,000 tons) at the end of the year. Consumption was up to 990,000 tons (786,000 tons) an all-time record, the main increase being in high purity zinc for die-casting for which purpose supplies have been increasingly short. Die-casting now accounts for 38 per cent of the total zinc consumption, the biggest use of die-cast zinc being in the automobile industry. There was also some increase in consumption for galvanizing, and for brass and bronze which in 1954 had fallen considerably.

In Canada, primary slab zinc production recovered to 231,000 tons (193,772 tons), the main increase being in high purity metal. Another recent important addition to world lead-zinc reserves is the deposit at Pine Point, on Great Slave Lake, Canada. Development of this large deposit, initially by open cut, must await rail connection with the Northern Alberta railway. Mine production in Mexico was also very much higher, resulting in considerable increases of both concentrates and slab zinc.

In Australia mine production was about 258,000 tons (252,659 tons), and refined zinc was slightly lower, 100,780 tons (104,523 tons) owing to power shortage at Risdon in the earlier part of the year. Consumption was up to 65,000 tons but although sales from Risdon continued at a high level, actual consumption fell towards the end of the year in keeping with other base metals in Australia.

Other Countries

In the United Kingdom, production of slab zinc was much the same as in 1954, 79,700 tons (81,239 tons); imports of slab zinc were higher at 161,582 tons (154,678 tons), imports from Canada in particular increasing, whilst those from U.S.A. fell abruptly. Consumption was a peace-time record at 251,600 tons primary metal (240,362 tons), and 95,000 tons (84,155 tons) remelt and scrap metal. The main increase in consumption was for die-casting and alloy purposes. Total stocks of slab zinc held at around 50,000 tons over most of the year, and were 49,962 tons at the close.

Production of zinc in concentrates in the Federal Republic of Germany remained at about the 1954 level, 117,000 tons (118,500 tons), but slab zinc increased to 117,000 tons (116,300), imports of zinc concentrates being much higher.

In France, also, production of slab zinc was rather higher than in 1954, whilst in Italy and elsewhere in Europe out-

put was at least maintained at the 1954 level.

Japan's production of slab zinc increased, particularly towards the end of the year, and with reduced exports of primary metal domestic consumption increased.

Outlook

A year or so ago it seemed that when the price of zinc was in the high £80's some industries tended to swing over to substitutes, particularly in die-casting. Recent increases in the price of other metals have greatly improved the competitive position of zinc. High prices for copper have increased the demand for aluminium, and the higher prices for and shortage of this metal have turned the scale for die-casters definitely in favour of zinc. At the present time a zinc price around £100, or 13½ c., need fear no metal competition for price reasons.

Although prompt zinc has been in tight supply over recent months, there has been no real shortage. Any slackening in the pace of industry in 1956 would result in some surplus. On the other hand, in a recent speech Mr. Jean Vuillequez, Vice-President of the American Metal Company Limited, has pointed out that in recent years zinc has demonstrated that its use could be increased relatively quickly if its price was attractive compared to available substitutes. During 1955, slab zinc production of the Free World increased by some 200,000 tons; nevertheless we witnessed a large reduction in Free World slab zinc stocks. This reduction was made possible by a very substantial increase of consumption, exclusive of important deliveries to the stockpile.

At the moment of writing, increasing credit restrictions in various countries have not reduced the level of industrial activity, and with it the demand for base metals. However, it is not unlikely that the effect of such restrictions may become apparent by the time this appears in print. With increased die-cast zinc used in automobiles, the demand for zinc as for lead will be increasingly dependent on the automobile industry, an industry notoriously susceptible to rapid changes in its level of activity.

The other chief use for zinc, galvanizing, is benefiting from the advancing development of the continuous lines. The product of these lines is superior and is gaining new markets. There are now 26 such lines in operation in the U.S. and an additional 15 are likely to be in operation in the near future. This substantial investment by the steel industry met with the co-operation of the zinc producing industry, which is supplying metal according to the varying specifications of each buyer. Thus, with continuation of the present U.S. policy of price maintenance, although prices are likely to recede somewhat from their recent high level of early 1956, no serious downward move seems likely such as to the level at the beginning of 1955, so that an average price certainly higher than that of 1955, may be expected.

There are signs that the long-term rate of increase in demand for zinc is greater than that for lead. The old tendency to regard zinc as virtually a by-product of lead mining persists to some extent, despite the greater demand for the lighter metal. It may be that recent metallurgical research will completely revolutionize the extraction of these two metals in the near future, permitting reduction in costs and re-alignment of treatment centres, and, concomitantly, a great expansion of world reserves.

Meanwhile, in terms of lead, zinc production is increasing rapidly and there is much potential output in ground which some day will be mined. An American authority has recently estimated that over the next ten years an increase of 10 to 25 per cent in the Free World's use of lead is necessary and that zinc must accordingly find markets to increase its use by at least 35 per cent.

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The London Metal Exchange

By Our Metal Exchange Correspondent

WHEN thinking back over the recent past the word which automatically springs to mind is "strikes," strikes at mines, smelters and docks, and it is true to say that these events had a bigger influence on the course of metal prices than any other factor. With rising consumption throughout the world and continuing stockpile needs, the various hold-ups in the flow of metals to world markets caused steep rises in prices which have been almost continuous except for minor corrective recessions which have all been of short duration. At the same time the shortage of free stocks gave rise to an almost continuous backwardation in the quotations of all the four metals dealt in on the London Metal Exchange.

The price fluctuations and the maintenance of backwardations gave rise to some criticism of the Metal Exchange, and it is worth while going a little deeper into the background of the market's behaviour during the last twelve months.

The L.M.E. Has Safeguarded Europe's Metal Supplies

Throughout the whole period world consumption has been rising at least as fast as the theoretical increases in production, but as the latter have been reduced by strikes the result has been an actual under-production of metals with consequent de-stocking by both producers and consumers and a continual battle for available supplies. The London Metal Exchange as a free international market has been the scene of this struggle, and the price fluctuations represent the tug-of-war for marginal supplies, primarily between America on the one hand and Europe on the other. It can be claimed that owing to the existence of the Exchange, Europe as a whole has never been desperately short in spite of the power of the dollar. That the fluctuations were large can not be denied, but in these days of high freight rates this must be so as the adjustment necessary to redirect the flow of metal in itself creates an appreciable fluctuation, and, as can be readily realised, the price level itself is liable to alter during such a change. In parenthesis it should be remembered that a £10 fluctuation in copper today compares with a £1 fluctuation in pre-war days. It will be seen, therefore, that the fluctuations have been necessary in order for the market to fulfil its function, and that it has done so is disputed by few.

The question of the backwardation is again the result of present-day trading practices and is in no way created by the machinery of the market: in general consumers tend to buy more nearby metal than in pre-war days, both because of war-time practices and also because of carrying smaller stocks owing to high prices, and this has resulted in nearby metal being worth a premium in view of the general scramble for supplies. Whilst on the question of the backwardation it is interesting to note that the application of the credit squeeze has begun to be apparent, and it is possible that as credit becomes tighter the market may have to carry some of the stocks which are at present financed by producers, which should have the effect of creating an appreciable contango.

LONDON METAL EXCHANGE DAILY PRICES, 1955.

A Strike-ridden Year for Copper

The copper market has been the one worst hit by interruptions in supplies, and as it is also the metal whose use has had the greatest proportional increase the price level has risen consistently over the year with only two short-lived major setbacks, one towards the end of April, 1955 when the U.K. Government announced the disposal of about 67,000 tons of copper and the other in the autumn when President Eisenhower became ill.

After the initial reaction to the U.K. Government's announcement it was realised that, under the conditions then existing, sale by tender, with pricing over an extended period but with the possibility of taking delivery reasonably promptly, should help the market by causing the purchase of three months' metal as a hedge. This occurred, but when these transactions started to fall due and normally would have been re-sold on the market the world situation was such that buyers were willing to take almost anything offered, and therefore physical delivery was taken which not only cut out a lot of would-be sellers but also set up a continual drain on stocks of copper available to the market.

The news of President Eisenhower's illness was followed very soon by an outbreak of strikes and an additional U.K. Government tender, which quickly reversed the downward tendency. The turn of the year saw a major strike in Chile which was quickly followed by one at the Phelps Dodge plant in America, and this caused the price to reach new record levels.

With the settling of these two strikes the labour picture became less menacing and the market ripe for a recession, and this was touched off in March, 1956 by the credit squeeze in the U.K. causing consumers to deliver their surplus metal on to the Exchange, and by the announcement of the Anaconda Co. that they were prepared to fix the price of all their Chilean-produced copper on basis of the London Metal Exchange quotations. This decision meant that more copper would go to America as the agreement that only one-third of the Chilean production should be sold in the States ceased to operate, and that this would ease the so-called "premium market" which, together with the London Metal Exchange quotations, has been throughout the year the real guide to the price of copper.

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Pricing Copper

During the year there have been a number of attempts to calculate a realistic price for copper in relation to production costs, and the most interesting computation was that 90 per cent of the world production could be sold profitably at about £200 a ton and 75 per cent at £150 a ton. It is hard to see, however, how pure economics can win control in the foreseeable future when the national economy of a country like Chile largely depends on its exports of copper, and it is to be expected that broader considerations than just the cost price of copper will control price movements. The crux of the matter seems to be the extent to which substitution takes place, and it is probable that a price for copper in the neighbourhood of £300 per ton will prove to be the point of balance betwen national economic aspirations and continued equity between production and consumption.

The year has also been noted for continued attempts to establish so-called stable prices for copper, as apart from the American domestic producers and the Belgian producers the RST announced that its copper would be sold at a fixed price for a period of one month and that thereafter alteration would be subject to twenty-four hours' notice. This principle was maintained for a few months, but it then became apparent that major movements in the world price level were taking place at very short intervals, and although the RST did in fact continue to maintain the same quotation for considerable periods it became subject to twenty-four hours' notice, which made it lose some of its attraction.

In the case of the U.S. domestic price this has been subject to large overnight alterations ; however the level has always been maintained well below that at which outside copper had to be purchased, and in some quarters this policy has been blamed for the unnecessarily high price reached, as consumers who had a major proportion of their requirements supplied at the official level were not discriminating buyers of the balance, being willing to pay almost any price asked for suitable parcels, and such purchases have established the level of the U.S. "premium market."

Tin's Uncertain Future

Although the flow of tin has not been seriously impeded there have been a succession of hold-ups in Malaya, and also the rail and dock strikes in the U.K. did not improve matters. Statistically there has been an over-production but this has been more than absorbed by the U.S. stockpile intake, and the movements both in the price level and the backwardation have sprung from the ebb and flow of demand in Europe and America. Once more it has been shown that when stocks tend to drain away from the market and the price level itself does not rise sufficiently to attract additional metal, the backwardation will increase to an extent that nearby material is diverted to the U.K. to rectify the position, and this was especially apparent in the early part of 1956.

In addition to commercial factors, buying has been influenced by the uncertainty of the future of the Texas smelter and the introduction of the International Tin Agreement. At the time of writing the life of the former has been extended until the end of 1956, whilst the future of the latter is still in abeyance, as although the required number of consumer votes had been recorded by August the Indonesian Government has not yet lodged the instrument of ratification which will give sufficient producer votes.

If the Agreement functions correctly there should be little difficulty in absorbing any surplus due to stockpiling ceasing and in maintaining the prices laid down, but the future must depend upon whether or not serious substitution takes place in the method of food-packing, as if this happens it is difficult to see any alternative use for the displaced metal even could there be a substantial fall in the price.

U.S. Stockpiling Featherbeds Lead and Zinc

The outstanding events of the lead and zinc markets are reported elsewhere, and it is sufficient here to say that fluctuations in the prices of these metals have not been as violent as in the cases of copper and tin as a smaller movement is required to cause free supplies to change their direction of flow; also there has been less disruption by strikes, the most important being those at the docks in the U.K. and in Australia. Consumption, however, has been steadily increasing, and with the U.S. Government's "support policy buying" as a sponge to absorb the small surpluses which appeared from time to time the price levels have been steadily rising.

The only serious shortage has been in the availability of high-grade zinc for the die-casting industry, but apart from causing some hedge purchasing on the Metal Exchange this has had no direct impact on the market and the state of scarcity has been shown by an appreciable increase in the premiums paid.

The LME Gradually Establishing Itself

The last twelve months have seen the London Metal Exchange taking a further step towards re-establishing itself as a world centre for metal prices. There are only two things now standing in the way of its re-establishing its pre-eminence. Firstly the necessity for governments to grant their nationals full freedom to use the Exchange, and secondly for executives everywhere to realise more fully the benefits which can be derived from operating on the market.

There is reason to believe that some progress in the former may be made during the coming year, but progress in the latter is dependent upon study and it is hoped that more companies will take the opportunity of discussing their problems with members of the London Metal Exchange.

Memo to Occasional Readers

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Aluminium

By SMITH BRACEWELL

THE rapid progress of aluminium was further accelerated in 1955. The unremitting efforts of the industry to expand existing markets and develop new ones have resulted in an ever-increasing demand from industrial users, which continues to absorb available supplies. Confidence in the future outlook is reflected by the many large projects for the further expansion of primary production announced during the year.

Production

Annual production of primary aluminium in the free world during 1955 reached a new record level of over 2,500,000 tons and that of the U.S.S.R. probably brought total world production to about 3,000,000 tons.

Climatic conditions in Canada during the latter part of 1955 and a temporary power failure at Kitimat owing to the break in a transmission line caused by a snow-slide led to a smaller expansion of Canadian primary production than the 80,000 tons increase which had been anticipated, and exports to the U.S. were reduced in consequence. In the U.S. in addition to the 1,400,000 tons of primary metal available from domestic production, 177,000 tons were available from imports and 363,000 tons of metal from scrap (14,000 tons of which were imported).

PRIMARY PRODUCTION

Excluding U.S.S.R. and satellites
(in thousands of long tons)

	1953	1954	**1955**
U.S.A.	1,118	1,304	**1,400**
Canada	490	498	**537**
W. Germany	105	127	**134**
France	111	118	**127**
Norway	55	60	***70**
Austria	43	47	**64**
Italy	55	57	**59**
Japan	45	52	**56**
Switzerland	29	26	***29**
U.K.	31	32	**25**
Other countries	26	31	**48**
Total	2,108	2,352	**2,549**

* Estimated

(Source: Mineral Resources Division of Colonial Geological Surveys and British Aluminium Co. Ltd.).

Increasing Production Capacity

The most reliable indication of the continued progress of the aluminium industry is provided by a study of the primary producing industry. At the end of 1954 there were 68 primary aluminium production plants in the free world with an aggregate production capacity of 2,500,000 l.tons. Such information as is available indicates the existence of some 16 reduction plants in the U.S.S.R. and her satellite countries with an aggregate capacity of about a half million tons.

During 1955 some 177,000 tons of new capacity was created in the free world by the expansion of existing plants and the construction of three new plants (in the U.S., Brazil and Tasmania). In addition, the capacity of many existing plants is to be further increased and about 10 new plants are in the planning or construction stage in the free world which will add a further 1,800,000 tons capacity. Roughly half of these projects are definitely agreed upon or under construction and half are of a more tentative nature. If and when all projects visualised at the time of writing are implemented, primary production capacity in the free world will attain the figure of 4,500,000 l.tons, and that of the whole world may approach 5,500,000 tons.

In the Americas

In the U.S.A. there were 16 reduction plants in existence at the end of 1954 with an aggregate annual production capacity of 1,314,000 l.tons. On August 15, 1955, the Anaconda Aluminium Co. opened its new plant at Columbia Falls, Montana, and this was expected to be operating at its full capacity of 54,000 tons by the end of the year. The expansion plans of the three other producing companies will bring U.S. production capacity to 1,794,000 tons within the next two years; i.e., the Kaiser concern has decided to expand the capacity of its three existing plants by 20,000 tons and to build a new 200,000 ton plant at Ravenswood, West Virginia, thus raising its total capacity from 364,000 to 584,000 l.tons; Alcoa will increase its total capacity from 580,000 to 656,000 l.tons and may build an eighth plant at Palacios, Texas; and Reynolds will increase its capacity from 370,000 to 500,000 l.tons.

Four other independent American firms may shortly enter the field as producers of primary aluminium. One of these, the Harvey concern, proposes to commence construction of a reduction plant of 54,000 tons capacity at Dalles, Oregon, early in 1956. Three other concerns, the Olin Mathieson Chemical Corporation, the St. Joseph Lead Co. (in association with the Pittsburgh Consolidated Coal Co.) and the Revere Copper and Brass Co., are planning construction of plants of similar capacity. If and when all these proposals are implemented U.S. primary production capacity will reach 2,010,000 l.tons per annum, or an increase of 696,000 tons on the figure at January 1, 1955.

It was recently reported that the Kaiser concern was studying the possibility of building a new reduction plant near Seven Islands, Quebec, Canada. It is understood that the National Metallurgical Corporation is still investigating the practicability of producing aluminium—silicon alloys by electric smelting in Lane County, Oregon.

Primary production capacity of the five Canadian reduction plants at the end of 1954 totalled 572,000 l.tons. The capacity of the new Kitimat plant is to be increased from 82,000 tons to 162,000 tons by the end of 1956 and to 300,000 tons by 1959, and that of the Isle Maligne plant in Quebec is also being expanded by 20,000 tons.

The British Aluminium Co. is to erect a reduction plant at Baie Comeo on the north shore of the St. Lawrence River, 200 miles east of Quebec. In combination with the Quebec North Shore Paper Co., a new company called the Canadian British Aluminium Co. has been formed with its head office in Montreal. Power will be obtained by an expansion of the Bersimis River hydro-electric project. This will eventually add 160,000 tons per year to Canadian production capacity and will be completed in four stages in 1957, 1959, 1960 and 1965.

In Brazil a new reduction plant owned by the Companhia Brasiliero de Aluminio came into operation on June 4, 1955. This is situated at Aluminio, near Sorocaba, 75 km. from Sao Paulo, and will use bauxite from the deposits at Pocos de Caldas. The initial output of the plant will be 10,000 tons per year, which, with that of the other plant at Saramenha in Minas Gerais, is expected to meet the country's present domestic requirements of primary metal.

In Europe

In Norway the capacity of the reduction plant at Tyssedal, owned by the Det Norske Nitridaktieselskap (a joint U.S., British and French concern) is to be expanded from 15,000 tons to 20,000 tons by late 1956. In addition the State-owned Aardal and Sunndalsora reduction plants are to be extended. The capacity of the Aardal plant is to be increased from 24,000 to 60,000 tons. Construction will be partly financed by a loan of $20,000,000 from Alcoa, to be repaid by monthly deliveries of aluminium over a 10-year period, beginning on

January 1, 1961. It is planned to increase the capacity of the Sunndalsora plant from 40,000 to 50,000 tons per year as soon as sufficient electric power becomes available. In April, 1955 power shortages led to the closing down of half the pots at this plant. A seventh Norwegian reduction plant of 20,000 tons capacity is to be built at Mosjoen in northern Norway by the Elektrokemisk A/S. The Swiss AIGG is also participating in this project. Power will be drawn from the hydro-electric plant at Rossaga. If and when these four projects are implemented primary aluminium production capacity in Norway will be raised from 96,000 tons to 169,000 tons.

Because of the low rainfall in Scotland during the summer of 1955 production of primary metal in the U.K. fell from 31,603 tons in 1954 to 24,445 tons in 1955. Demand continued to grow, however, and despatches of primary metal to consumers increased from 225,202 tons to 286,195. To meet this demand, imports (mainly from Canada) were increased from 191,766 tons in 1954 to 255,406 tons. This high rate of imports was possible because the U.K. has a first call upon a large part of Canadian production.

In Western Germany the production capacity of the reduction plant at Erft has been considerably increased and there has been some expansion of the plant at Toging. In Austria the capacities of the State-owned reduction plant at Ranshofen and of the Swiss-owned power station and reduction plant at Lend have recently been increased. In Spain the Empresa Nacional del Aluminio has been authorized to increase the production capacity of its reduction plant at Valladolid from 3,000 to 10,000 tons per year.

Elsewhere

The Indian Government has recently issued a licence for the construction of a new reduction plant with an initial capacity of 10,000 tons by the Indian Aluminium Co. (a subsidiary of Aluminium Limited) as part of the Hirakud project in the State of Orissa. Projects submitted by the respective State Governments for consideration by the Government of India in framing its second Five Year Plan include the construction of aluminium reduction plants in Madras, Mysore and the Punjab.

The new reduction plant constructed by the Australian Aluminium Production Commission at Bell Bay, Tasmania at a cost of £10,000,000 commenced the production of metal on September 23, 1955. The plant is designed to produce 13,000 tons per year, equivalent to 70 per cent of the country's present domestic requirements, but the attainment of this output will depend upon the availability of sufficient power.

Considerable interest is being evinced in the potentialities of West Africa as a producer of bauxite and aluminium. The Gold Coast Volta River project is still under investigation and the Secretary of State for the Colonies recently stated that he hoped to receive the report of the Preparatory Commission by the middle of 1956. Work is now under way on the aluminium reduction plant which is being built in the French Cameroons by Alucam, a venture financed partly by the French Pechiney and Ugine concerns and by the French and Cameroon Governments. The plant is designed for an initial output of 45,000 tons per year and for eventual expansion to 100,000 tons. Power will be provided by an expansion of the existing hydro-electric generator at Edea.

In addition the two French aluminium producing companies are collaborating with German, Swiss and Italian concerns and with the Société des Bauxites du Midi, a French subsidiary of Aluminium Limited, in an investigation of the hydro-electric resources of the Konkoure River in French Guinea and the Kouillon River in the French Middle Congo with a view to the eventual establishment of another reduction plant. The falls in the Konkoure River are situated near the bauxite deposits of Kindia, and Boké in French Guinea. In Nyasaland further development of the large bauxite deposits of Mlange Mountain may depend upon the results of investigations of the Shire River project.

In Japan primary production is steadily expanding and it is reported that the Nippon Light Metals Co. is to re-open the plant at Niigata, idle since 1945, which may increase production by a further 20,000 tons per year. Annual production is expected to reach about 70,000 tons by 1957.

Plans for the establishment of a primary aluminium production industry in Surinam (Dutch Guiana) are reported to be well advanced. These envisage the construction of a dam across the Surinam River at Brokopondo Falls which would provide sufficient power to produce 40,000 tons of metal per year. The production of aluminium is also visualized in a project for the construction of a hydro-electric generator in the Caroni River, Venezuela.

Prices

Effective from January 1, 1956, Alcan increased its price for 99.5 per cent primary aluminium ingot by 1¼ c. to 22¼ c. per lb. Related adjustments were made in all other export markets except the U.S. where the price of pig is 22½ c.

The price of primary aluminium of 99.5 per cent purity, delivered to consumers in the U.K. was raised from £156 to £163 per l.ton on January 1, 1955, to £171 on July 1, 1955, to £179 from January 1, 1956, and to the present figure of £189 in April 1956.

Government Controls

In the U.S.A. the system of allocating certain amounts of available aluminium each quarter to meet possible defence and atomic energy requirements introduced in 1953 was continued, but owing to the pressure of civilian requirements amounts so set aside were released later on to industrial users. Some 10,000 tons of the amount originally set aside during 1955 was diverted to the U.K. in part repayment of the 80,000 tons made available to the U.S.A. by the British Government from Canadian production in 1952-53.

Bauxite and Alumina

Annual bauxite production in the free world increased from 13,000,000 tons to about 13,900,000 tons. The most notable increase was that in Jamaica where output rose from 2,000,000 tons in 1954 to 2,644,345 tons in 1955. Slight increases were reported in British Guiana, Malaya, France, Yugoslavia and French West Africa, and slight decreases in the Gold Coast, the U.S.A., and Surinam. During the year it was announced that the alumina plant of Alumina Jamaica Ltd. is to be expanded and its production capacity raised from 210,000 l.tons to 490,000 l.tons per year, at an estimated cost of $28,000,000. Reynolds Jamaica Mines Ltd. also are to construct an additional kiln, overhead tramway and larger storage facilities for bauxite in the island. It is probable that in the near future, therefore, bauxite production of Jamaica will exceed 3,000,000 tons per year. The Anaconda Aluminium Co. has recently developed a process for making aluminium from clays and has acquired clay deposits in the Pacific North-west.

Future Outlook

In a study prepared for the Royal Commission on Canada's economic prospects, Alcan predicted a "long-term growth" in world demand for aluminium based on the growth in population, rising living standards, and the industrialization of previously "backward" areas. A growing appreciation by manufacturers and consumers of aluminium's properties, the development of new uses for aluminium through research and development programmes, and a favourable price situation were among the reasons advanced in support of these predictions. Current expansion projects are based on peacetime markets and are indications of the industry's determination not to lose market possibilities for lack of adequate supplies.

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Magnesium

THE year 1955 was a memorable one in the history of magnesium, because it was the first in which the quantity consumed in the U.S. for civilian purposes exceeded the total purchases on U.S. Government account. Requirements for consumer goods were expected to account for 10 per cent of the total usage, compared with 3 per cent in 1954. The Dow Chemical Co. is confident that with the help of lower costs, lower production methods, and more intensive product research, a steadily growing share of the light-metal market can be secured.

World Production

Available figures indicate that world production of magnesium metal in 1955 approximately equalled the 1954 total of 140,000 s.tons. In 1954 the U.S. produced 69,729 s.tons, equivalent to virtually half the total output. All U.S. production is from the Dow plant at Freeport, Texas, and from the government-owned plant at Velasco, Texas, operated by Dow under a lease agreement valid until January 31, 1958. Total U.S. production of primary magnesium in 1955 was 61,135 s.tons. For the first time for several years Dow is now operating both plants at the full annual capacity rate of 75,000 s.tons.

Other leading producers are the U.S.S.R. (which in 1954 produced an estimated 45,000 tons), Canada, the U.K. and Norway. It is estimated that the two Canadian producers—Dominion Magnesium Ltd., and Alcan's wholly owned subsidiary, Magnesium Co. of Canada Ltd.—produced over 7,000 tons of metal last year against 6,600 tons in 1954. In the first seven months of 1955 Canada exported about 4,200 tons of magnesium, the U.K. being the largest buyer followed by Japan. The U.K. produces about 2,000 tons of metal a year and is adequately supplied at an ingot price of 2s. 4d. a lb. In 1955 consumption rose to approximately 11,000 tons compared with 7,500 tons in 1954.

Until about two years ago magnesium sheets were twice as expensive as aluminium sheets. To overcome this problem a large rolling mill costing $50,000,000 was constructed by Dow at Madison, Illinois. In the U.S., magnesium sheets now cost 61 to 91 c. a lb., depending on thickness, compared with 41 c. to 48 c. for aluminium. Dow's new rolling mill is still operating at about 50 per cent of capacity, but it is believed that at current prices many more customers can be found. In the U.S. the price for 99.8 per cent ingot rose in three stages from $27.5c. a lb to the current $34.2c. per lb.

Expansion of Civilian Uses

One of the largest outlets for magnesium is the motor car industry where over 100 applications have been reported. One pound of magnesium can replace 4 lb. of zinc costing nearly twice as much in pressure die castings. This price advantage was offset till recently by the higher costs of casting magnesium, but Dow engineers have developed an automatic "hot chamber process," that is expected to make magnesium pressure die castings competitive with zinc. The world's largest single consumer of magnesium is the Volkswagenwerke in West Germany. Each Volkswagen uses some 36 lb. In the U.S. another large outlet is presented by photo engraving plates, which are expected to consume some 600 tons of magnesium in 1956, equivalent to treble the 1954 total.

The magnesium industry looks forward to an even better year in 1956. There is no evidence of any decline in military needs and advance orders indicate that requirements for commercial and consumer usage will continue to rise.

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Titanium

TITANIUM ended the year 1954 on a slightly hesitant note. Despite rapid expansion of production and fabricating capacity in the U.S., some aircraft manufacturers expressed dissatisfaction with the quality of the metal, while producers and fabricators were reported to be concerned with marketing uncertainties arising from the Government's expansion programme. Much progress in overcoming these difficulties was achieved in 1955, which was also memorable for notable developments in the United Kingdom.

For the first time the Free World production of titanium metal exceeded 10,000 tons. According to a semi-official report, late in 1955, the Russians are producing more titanium metal than the U.S.

U.S. Production

The U.S. production of titanium sponge rose last year to 7,200 s.tons, representing a gain of about 34 per cent over the 1954 output, which was more than double the 1953 figure of 2,241 tons. Due to improved extraction techniques, the price of first-grade titanium in the U.S. has dropped in stages to $3.45 from $5 at the beginning of 1954.

Titanium sponge purchased by the U.S. Government during the year, under the General Services Administration purchase and resale programme totalled 3,552 s.tons, increasing the total in the revolving fund stockpile to 6,446 tons. Government agreements with Du Pont and Titanium Metals Corporation to purchase titanium sponge under this programme terminated on September 30, 1955. Government assistance for the creation of additional titanium sponge capacity was suspended by the Office of Defence Mobilization on September 12, 1955. The programme, however, is to be kept under constant review. Contracts signed by the Government under the past titanium metal expansion programme called for an annual titanium output of 21,600 s.tons in 1957. Operations are to continue.

This action was taken after a review by Mr. Harold S. Vance, Special Consultant to the Defence Mobilization Board. This expert recommended that GSA should include Brinell hardness specifications which would achieve higher quality and greater uniformity of titanium sponge in the event of future purchase contracts and should hold purchases of titanium sponge to a minimum consistent with the continuing development of a better product.

GSA has signed an agreement with the Bureau of Mines for a two-year programme of research and development aimed at the development of a more economical process for producing titanium tetrachloride from domestic titaniferous raw materials. Battelle Memorial Institute has been awarded a $1,000,000 contract to establish a titanium metallurgical laboratory, which is to concentrate initially on problems associated with the production and application of titanium for military equipment. Further agreements provide for experiments with a new fused salt process for the production of titanium metal and for a new method of obtaining titanium from impure scrap metal. The construction of a large titanium tetrachloride plant at Natrium, W. Virginia, was announced by Columbia-Southern Chemical Corp.

I.C.I.'s Low Production Costs

In the U.K. the plant built by Imperial Chemical Industries to produce 1,500 tons of titanium a year by a new sodium process of their own development came into operation during 1955 and is now operating virtually to capacity. Recently I.C.I. announced a reduction in the price of their raw titanium to about 21s. (below $3) per lb. This means that I.C.I. are producing titanium of the highest purity at the lowest price in the world. Instead of the coke-like sponge of the conventional Kroll process, their product is in the form of small granules which can be pelleted with alloying materials ideally suitable for melting. It was announced in August that I.C.I. and Columbia-Southern Chemical Corporation had submitted a joint application for a contract whereby the U.S. Government would undertake for a five-year period to purchase 5,000 s.tons p.a. of granular titanium metal by I.C.I.'s sodium reduction process.

I.C.I. also announced their intention of building a factory at Swansea for the fabrication of titanium, which should be in production by 1958. A titanium melting plant under construction at Birmingham by William Jessop and Sons, a subsidiary of B.S.A., is reported to be nearly complete.

Titanium will be used extensively in the Bristol Proteus 755 turbo-prop engines which power the long-range Bristol Britannia airliners. The Bristol Aircraft Co. estimate that the total weight saving will be about 560 lb. per aircraft.

Another notable achievement is the development by Canadian Steel Improvement, a member of the Hawker Siddeley Group, of a new method of forging titanium, which eliminates much of the previous difficulty and cuts costs.

An estimated 1,800 tons of titanium metal were produced by five Japanese companies, two of which have contracted with the U.S. Government for the exchange of 1,300 and 700 tons of titanium sponge respectively for surplus American farm products. The Japanese plan to expand output to 2,600 tons in the next financial year.

Titanium Compounds

Demand for titanium compounds—still by far the largest outlet for ilmenite and rutile—also continues to expand. In the U.S. domestic production and shipments of titanium pigments in 1955 are estimated at 10 and 15 per cent respectively above the records established in 1954. Canada's first titanium pigment plant is to be constructed near Varennes, Quebec, by Canadian Titanium Pigments Ltd., a subsidiary of the National Lead Co. It will cost $15,000,000 and employ 400 people. Expansion of titanium dioxide facilities was also undertaken last year in Germany, and by British Titan Products and Laporte Titanium in Britain.

Titaniferous Ores

In September last year National Lead reported the discovery of large deposits in Tahawus, New York; Trail Ridge, Florida; and Sokndal, Norway. Re-examination by A/S Titanic of its extensive holdings near Jossingfjord, Norway, has revealed deposits estimated to contain more than 100,000,000 tons of ilmenite. This will enable the company to raise its annual production of ilmenite concentrates from 16,000 tons to over 200,000 tons.

During 1955 there was a marked rise in the production of rutile concentrates from beach sands in Australia. In January-September, 1955, output reached 42,713 tons compared with 31,126 tons for the same months of 1954. Production is expected to increase still further in 1956.

British Titan Products is shortly sending out a team of experts to Sierra Leone to study the possibility of working the titaniferous deposits of the Bonthe and Moyambe districts. An option has been granted to Anglo American Corporation to purchase assets owned by the Titanium Corporation on the Natal Coast, where ilmenite is believed to exist in large quantities in beach sands. The Transkei coast may become one of the largest potential sources of titanium minerals in the world.

Iron and Steel

By J. H. THOMPSON

DURING the now completed decade since the end of the second World War, British steel production has increased by two-thirds—five tons of steel now for every three tons in 1945 : pig iron production is 75 per cent higher and throughout the whole period the industry has spent over £1,000,000 a week on modernization and expansion of capacity. From time to time doubts have been expressed lest the sights had been fixed at too high an altitude. " Risk " capital under public and private ownership has not been spared but there have been periodic fears of redundancy.

In the event the pace of re-equipment has proved to be too slow. Domestic and world requirements have far exceeded the most sanguine estimates, and in the race for expansion of capacity British steel, which was first in the field with a comprehensive development programme, has been outpaced by its principal competitors.

Expansion of Steel Production

During the ten years 1946-1955 the world's steel production—and presumably its steel consumption also — has risen from 110,000,000 tons to 260,000,000 tons — an increase of nearly 150 per cent. Nor is there any sign of a halt in the rising trend of ingot production.

Still more ambitious investment programmes have been planned. U.S. steel companies propose to add about 5,000,000 tons to their ingot capacity each year for the next three years at an estimated cost of three billion dollars. For the Soviet bloc no target figures have been announced, but the re-orientation of Russia's economic policy provides for the more rapid development of the heavy industries with steel in a foremost place. Western Germany has already surpassed the U.K. to take third place in the list of steel producers and means to increase her lead. France, with a new record of 12,500,000 tons of crude steel last year, is revising an investment programme in the light of the admitted fact that the growth of production is less rapid than in the other member states of the European Coal and Steel Community.

India is definitely committed to the attainment of an annual output of 6,000,000 tons (more than double present capacity) and contemplates further expansion to an ultimate target of 9,000,000 tons. New blast furnaces and steel plants are in course of construction in Canada, South Africa, Australia, Brazil, Venezuela, Spain and Turkey. Czechoslovakia broke new records with a crude steel output of 4,500,000 tons last year and installation of a new open hearth furnace and an additional tilting furnace at Sisak and Zenica has raised Yugoslavia's output to 663,000 tons.

Not surprisingly the estimates of the demand for British steel have been the subject of further scrutiny and revision. A prominent member of the Iron and Steel Board has admitted that the demand for steel last year was greater than the original estimate for two years ahead. Anticipations of future events are at all times exposed to a wide margin of error, and in this case caution has been heavily penalized, since a demand far in excess of available supplies has necessitated a restriction of steel exports and near record imports, at heavy cost to our strained external credits.

WORLD CRUDE STEEL PRODUCTION

(million tons)

	1953	1954	*1955
U.S.A.	99.65	78.85	**103.00**
U.K.	17.61	18.52	**19.79**
W. Germany	15.18	17.16	**20.97**
France	9.84	10.46	**12.36**
Belgium	4.43	4.85	**5.79**
Luxembourg	2.62	2.78	**3.17**
Italy	3.48	4.13	**5.29**
Saar	2.64	2.76	**3.11**
Netherlands	0.86	0.91	**0.96**
Other West European Countries	5.18	6.00	**7.00**
U.S.S.R.	37.30	40.00	**44.50**
Canada	3.67	4.00	**4.04**
India	0.92	1.47	**1.69**
Australia	1.82	2.13	**2.20**
South Africa	1.22	1.36	**1.50**
Latin America	2.04	2.20	**2.30**
Japan	7.53	7.70	**9.70**
World Totals	230.40	219.59	***261.00**

* Estimated.

Britain's Future Needs

British producers are now making some progress towards the achievement of a balanced output. Following a rise in ingot production amounting to 1,250,000 tons last year, the British steel industry has budgeted for a further increase of 1,500,000 tons in 1956, and in the first quarter the estimated annual rate of 21,300,000 tons was easily exceeded.

Two years hence the second post-war development plan will be completed and in consultation with the Iron and Steel Board the industry has embarked upon a further survey of the plant requirements which are deemed to be necessary to keep this country in the van of progress. It is a problem of extreme perplexity to the solution of which no ready answer is provided by past experience. The second decade after the first World War, began a period of catastrophic depression followed by a slow and painful recovery.

Will the great post-war boom since 1945 prove to be the prelude of another slump or should we prepare for a continuance of the boom? There are questions to which it is vital that the steel industry here and elsewhere should find the correct answer. Be it remembered that steel capacity cannot be created overnight. Between the preparation of the blueprints, the raising of the capital, and the creation of the plant, years may elapse. Decisions now will determine the extent of steel supplies in 1959 and 1960.

In this connection an examination of the appended statistics of world steel production may be instructive. The figures are given in terms of million l.tons :

1870	0.51	1900	27.83	1930	93.59
1875	1.79	1905	44.22	1935	98.03
1880	4.18	1910	59.33	1940	139.25
1885	6.19	1915	65.57	1945	113.09
1890	12.28	1920	71.30	1950	186.61
1895	16.65	1925	89.05	*1955	260.00

* Estimated.

From the above it will be seen that, eliminating short-term fluctuations, the rising trend of steel consumption has been continuous. No doubt arrested developments during the long period of hostilities, gave a tremendous impetus to the post-war demand, but by 1953 there was a fairly sharp contraction. Demand was hesitant in the area administered by the High Authority of the infant Coal and Steel Community, and contracted also in both the U.S. and Canada. The depression proved to be short-lived, and it is a notable fact that the largest subsequent increases in steel consumption throughout the Free World took place where there was little or no war damage; e.g., the U.S.

The American Republic produces very nearly half the steel output of the whole world and last year exported no more than 4,000,000 tons—about 650,000 tons more than the U.K. but 1,800,000 tons less than Belgium and Luxembourg. The *per capita* rate of steel consumption in the U.S. is approximately 12.5 cwt. per annum—by far the largest figure in the world—and the U.K. ranks second with a *per capita* consumption of rather less than 8 cwt.

In the assessment of the probable demand and supply of steel it is customary to think in terms of engineering products, bridges, ships, railway developments and more recently oil and gas pipelines. In this respect American aid to speed European recovery and Asian development has provided a powerful impetus, but a new factor in the equation is the growing tonnage of steel which is devoted to the manufacture of desirable household goods. House building in the U.K. absorbs not less than 150,000 tons of iron and steel and very much larger tonnages are required, particularly in the U.S., by the makers of refrigerators, washing machines and metal furniture.

U.K. STEEL RECORDS

	1954	1955
	Tons	*Tons*
Pig iron production	11,883,000	**12,470,000**
Crude steel production	18,520,000	**19,791,000**
Iron and steel imports	763,700	**2,321,300**
Iron and steel exports	2,352,700	**2,727,800**
Ore imports	11,611,250	**12,896,500**
Home ore production	15,558,000	**16,177,000**

Of 15,000,000 households in this country over one in four is without a bath. Only one-eighth of Britain's urban homes are equipped with water heaters, one in ten has a washing machine and fewer still a refrigerator. All these are part of the normal equipment of the American home and in this and other countries, similiar amenities will similarly be sought as the general standard of living rises.

For sheets for containers, and tinplate for the canning industry, demand has so far out-distanced the supply that even America's huge capacity is overwhelmed. Big extensions to the mills in Cheshire and South Wales having failed to obviate the necessity of large-scale imports of sheet and strip from the U.S. at an almost prohibitive cost in precious dollars, the Iron and Steel Board is examining the pros and cons of a scheme to build an additional mill at an estimated cost of £100,000,000.

Expansion of steel capacity is not a simple matter of building the necessary plant.

Fuel and Mineral Resources

A necessary preliminary is an assurance of ample supplies of raw materials chiefly coal, iron ore and limestone. Since it takes roughly 3½ tons of these materials to produce a single ton of crude steel, it is arguable that the main physical limits to the increase of steel production are ultimately fixed by the availability of fuel and mineral resources.

Both the U.K. and Western Europe are affected by a shortage of coal production which imposes the need for imports, but advances in technical efficiency, the use of more low-grade coals by blending and the extending substitution of oil fuel have enabled the industry in these areas to solve most of the difficulties which might otherwise have proved to be an insuperable bar to expansion.

In the case of iron ore the quest for increased supplies has ranged far and wide and has been prosecuted with unremitting energy. In Britain the main sources of supply are yielding diminishing returns. The more accessible deposits moreover have a low Fe content and blast furnacemen are compelled to use ever-increasing tonnages of foreign ore.

There are still ample tonnages in sight, but for these it is necessary to go further and further afield and to dig deeper. Discovery of new deposits is not enough. Accessibility is a governing factor. Development of a new mining area involves huge expenditures on equipment, railway and shipping facilities. These problems of expansion face all the main steel producing countries, and in the absence of ample indigenous supplies, steel plants on coastal sites enjoy an obvious advantage.

For some years past the declining yield of Lake ores has compelled American steel interests to develop new sources of supply and they have linked up with Canadian interests in the development of the vast deposits in the regions of Quebec and Labrador. These areas produced 7,250,000 tons in 1954, more than doubled this output in the succeeding year, and have fixed a target of 20,000,000 tons in the current year, rising to an annual rate of 38,000,000 tons by 1970.

Newly developed ore fields in Venezuela, Brazil and Liberia are also making their contribution to the insatiable appetite of American blast furnaces and in addition projects are well advanced for the production of taconite concentrates from the enormous deposits of lean ores which are to be found within the frontiers of the United States.

Improved Iron Ore Supplies

For the U.K. and for Western Europe the position is more favourable than it was a year ago. Less than twelve months have elapsed since a leading Scottish steel manufacturer was moved to forecast a partial shut-down of the works unless there was a speedy acceleration of iron ore imports. Ore carriers had been diverted to the transport of American coal to Britain, and ore reserves had run down to a perilous degree. Happily the shortage of cargo space was overcome, and U.K. imports have since been running at the record rate of over a million tons a month.

Leaving nothing to chance British steel interests have entered into a partnership with established shipping companies to build a large fleet of specially designed ore carriers. It is estimated that by 1959 the industry will have under its control sufficient shipping to carry about 9,000,000 tons of imported ore, which is about 50 per cent of the total requirements. Much modern ore unloading and preparation plant has also been installed and by achieving a quicker turn round at the ore ports a substantial saving in transport costs has been effected.

Whether collectively or privately owned, the ore shipping fleet is not immune from the effects of rises in the freight market and it is estimated that the cost of foreign ore with a 55 per cent iron content delivered to the British blast furnaces is now well over £5 per ton. As recently as December, 1955, pig iron prices were advanced to take account of an average increase of 10s. a ton in the price charged to consumers of imported ore.

Big developments for the further increase of ore production in Sweden, whence the U.K. already draws 35 per cent of its imported supplies, and in the Dunderland Valley in Norway are also in progress. North Africa, and Sierra Leone continue to provide substantial tonnages and the Conakry ore field in French Guiana opened up three years ago is also providing an increasing volume of material.

Thus it would appear that calculated ore requirements over the next few years are amply covered, and no lack of raw materials seems likely to constrict such further plans for the increase of steel production as may be formulated and approved in the immediate future.

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Nickel

By A. GRAHAM THOMSON

SO versatile a material is nickel that over 3,000 alloys in current production contain from fractional up to major percentages of this metal. The largest outlets are presented by stainless steels and engineering alloy steels, but increasing quantities of nickel are also being used in the cast iron and electroplating industries and as catalysts and magnetic alloys. Because of its outstanding high temperature properties nickel is in growing demand as a constituent of alloys used in the construction of jet engines and also of atomic reactors.

So rapidly are new uses being developed and existing fields of usage expanded that supply has not yet overtaken demand, although production has been expanding for several years. Last year Free World supplies from all producers reached the new peak of 213,500 s.tons—an increase of some 10 per cent over 1954 and 25 per cent over 1953. With heavier needs for defence and for civilian industry, however, and with stockpile demands continuing, the increased supply was insufficient to satisfy civilian requirements fully. In compensation for its increased defence demand, the the U.S. Government initiated a programme of diverting to industry some of the nickel scheduled for stockpiling.

Expansion of Output

For the sixth successive year International Nickel operated to the limit of its capacity, mining more ore from underground and delivering more nickel than in any previous year. The company supplied 145,000 tons of nickel in all forms, an increase of 2,000 tons over the record deliveries of 1954. In addition, it made available 5,200 tons of metallic nickel by converting sinter and concentrates supplied by other producers. While mill product shipments were about the same as in 1954, INCO's rolling mills in the U.S. and the U.K. were again compelled to operate below capacity because of inadequate supplies of nickel.

The tonnage of ore mined from underground was the largest in the company's history, amounting to 12,759,482 s.tons. During the year two ore haulage tunnels were driven in the rock walls at the Frood-Stobie open pit, making an additional 3,500,000 tons of ore available for mining by low cost open pit methods. At the end of 1955 the company's proved ore reserves stood at 262,369,185 tons, the highest on record.

In the first six months of 1955 Falconbridge's production of refined metal rose by 20 per cent and of nickel in matte form by six per cent. Steady progress was made during the year towards completion of the company's new construction programmes, which are designed to raise production to 50,000 tons a year by 1960.

The production of nickel at the refinery of Sherritt Gordon Mines, Ltd., at Fort Saskatchewan, Alberta, was restricted during the first quarter of 1955 by difficulties with plant, but by August the rate of output had been raised to more than 10,000 s.tons annually. Good progress is being made by the Hanna Nickel Smelting Co., which started the construction of mine and plant facilities near Riddle, Oregon, in mid-1952. In the first ten months of 1955 this company produced 6,550 s.tons of ferro-nickel averaging 42.43 per cent nickel and containing 2,780 tons of metal. The ultimate capacity of the plant will be at least 7,500 tons of nickel contained in ferro-nickel.

Cuba has become a major source of nickel, accounting in 1955 for approximately seven per cent of the total Free World production. The plant at Nicaro owned by the U.S. Government is now running at an annual rate of over 15,500 s.tons and has produced a total of about 50,000 s.tons since 1952 when it was re-opened. This increase in production has been accomplished simultaneously with plant expansion, which will eventually increase capacity by seven per cent over the present rate of production. The target date for the expansion programme is October, 1956.

Nicaro Nickel Company, a wholly owned subsidiary of the Freeport Sulphur Company, completed its pilot plant near New Orleans late in 1955. This plant will be used to test a new process for producing nickel and cobalt from deposits at Moa Bay, 40 miles east of the town of Nicaro. On successful completion of the experimental work a commercial plant for the production of these metals will be constructed.

A plan to modernize New Caledonia's nickel industry envisages the construction of a dam and power plant on the Yate river capable of producing 340,000,000 kWh. per year and the erection of four electric smelters. The mining company, "Le Nickel," has been granted Treasury facilities to equip its mining and metal processing plants. Its programme of modernization and expansion aims at 10,000 tons of metal in 1955 and 1956, rising further to 12,000 tons in 1957.

Four United States companies as well as two Philippine concerns, are planning to develop iron ore deposits in the Philippines. Situated in the Surigao area of Nonoc Island, these deposits are estimated at 29,000,000 tons containing 1.38 per cent of nickel ore.

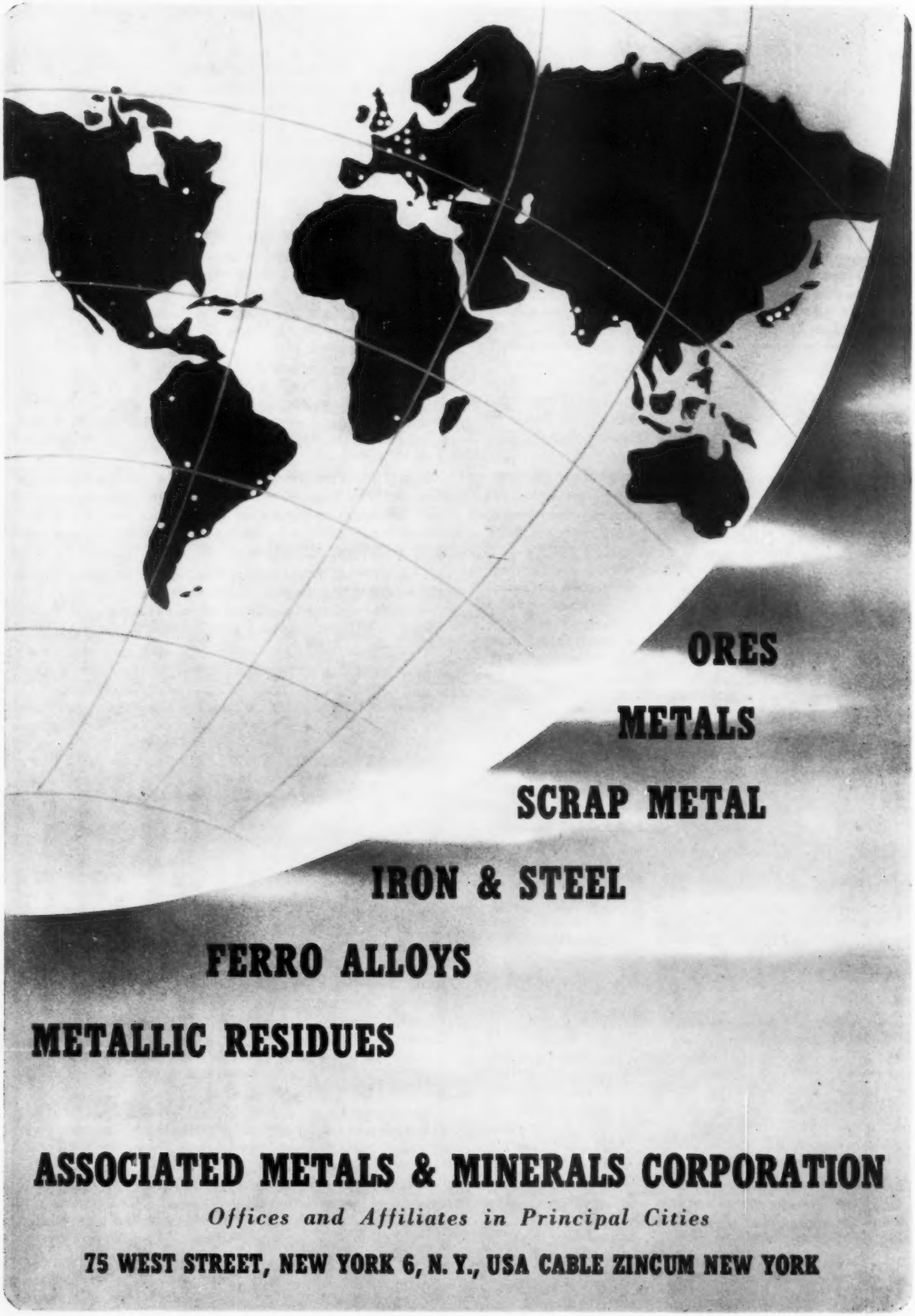
The Greek Government has approved a loan of $2,500,000 to the Greek Chemical Product and Fertilizer Company for the Larymna nickel project, planned in co-operation with the German firm of Krupp.

The discovery of rich deposits of nickel and cobalt ores in the most accessible part of the Cyclops Mountains, Netherlands New Guinea, was reported in December, 1955. The Dutch New Guinea Commission was quoted as stating that the erection of processing plant in New Guinea was worth consideration. A nickel deposit regarded as very promising has been found in the Gatooma area of Southern Rhodesia. An option to investigate the claim has been bought by Mineral Search Ltd., a subsidiary of Rio Tinto.

The Outlook

Free World production of nickel in 1956 is expected to reach an estimated 221,000 s.tons. This higher output should result in more of the metal becoming available for industry than in 1955, but the tight supply position could only be substantially alleviated by a reduction in stockpiling and defence requirements, which together account for about half the world's nickel consumption. The U.S. Defence Materials Procurement Agency has made a number of long-term agreements designed to cover all future American defence and stockpile needs. Thus INCO, in addition to its other large development projects, is investing $16,000,000 in the treatment of low-grade ores in order to supply D.M.P.A. with an additional 60,000 s.tons of nickel over the period 1954-58.

Though producers can sell all they can supply, it is evident that stockpiling will continue indefinitely and that the future of nickel must ultimately depend on the continued expansion of civilian usage. The industry has, therefore, been devoting much effort to product research directed toward developing future markets for nickel. Many promising applications have already been developed and only await a more favourable supply position. Other studies are in progress.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Manganese

THE world output of manganese ore has more than doubled since 1949 and now exceeds 10,000,000 tons annually, about half of which is produced by the U.S.S.R. Approximately 95 per cent of the total supply is used in the manufacture of steel, 3 per cent in the dry battery industry, and the balance in the chemical industry.

The Free World supply comes mainly from India (28 per cent), Union of South Africa (14 per cent), Gold Coast (9 per cent), French Morocco (8 per cent), and the Belgian Congo (7¼ per cent). There is increasing production of manganese ore in Spanish Morocco, Brazil, Cuba, Turkey, Mexico, Egypt and Japan.

Production and Marketing

Towards the end of 1955 the recession in the U.S. led to a fall in American steel production, with consequent reduction in the demand for manganese ore. In August, 1954, ore of 48 per cent grade was quoted at 68d.-70d. a unit, c.i.f. Europe, compared with 95d.-100d., at the beginning of the year. American steel production then resumed its upward progress and a substantial recovery in prices took place in 1955.

In India the improved market for manganese ore resulted in the re-opening of mines that had been closed down owing to the fall in prices. Production figures are not yet known, but there is believed to have been an improvement over the previous year. Railway transport was not very satisfactory, especially from Madhya Pradesh, but it is probable that exports exceeded 1,000,000 l.tons. The continued shortage of locomotives and wagons was accentuated by rising demands from other industries, due to the increasing industrialization of the country, but the situation is improving. The heavy media separation plant at Dongri Buzurg is operating successfully and several of the larger mines in the State were connected to the system. A notable development in India is the rapid expansion of ferromanganese production, which is being raised to an annual capacity of 160,000 tons during the second five year plan.

The Union's production of manganese ore rose to 679,569 s.tons in 1955, compared with 594,517 tons in 1954 and 912,339 tons in 1953. The first major export shipments of high-grade ore from the Citrusdal area in the Cape Province left Cape Town at the end of May. They were expected to be the forerunner of a steady flow of manganese exports to markets in the U.S. and Europe. In French Morocco production was slightly higher last year, rising to 371,500 tonnes (357,000 tonnes in 1954).

Shipments from the Gold Coast during 1955 totalled 539,580 tons (710,700 tons in 1954).

Exports of ore from Brazil should increase materially in 1956 with the advent of shipments from the Amapa deposits in which Bethlehem Steel Corporation has an important interest.

The Vanadium Corporation of America has purchased the Baharti manganese mine near Fort Rosebery in Northern Rhodesia. A subsidiary company has been formed to work the deposits, which are believed to be of high quality.

An American firm was reported to be negotiating with the Pakistan Government for prospecting rights over manganese deposits in the Lasbella district of Baluchistan.

A preliminary report on extensive manganese deposits in the Uptata district of Bolivar State, Venezuela, is couched in optimistic terms. There are claimed to be several million tons of ore with a manganese content ranging from 28 to 55 per cent.

A 33-year lease to explore and develop manganese and associated mineral deposits over 60 sq. miles of British Guiana has been granted to the Canadian-owned North West Guiana Mining Co. Ltd.

U.S. Domestic Programme

For several years the U.S. has sought to reduce dependence on imported supplies by an incentive purchase scheme for domestic ores. This scheme has substantially increased domestic output, which amounted in 1955 to an estimated 300,000 s.tons of ore containing 35 per cent or more of manganese.

The U.S. Bureau of Mines is conducting large-scale research to develop economical methods of upgrading domestic ore and of recovering manganese from furnace slag. As part of its long-range efforts to reduce dependence on foreign sources, it has succeeded in making standard ferromanganese from Artillery Peak, Arizona, ore. The General Services Administration has entered into a contract with Ore Beneficiation Incorporated for erection of a pilot plant at Joplin to handle slag and low-grade ores from various parts of the country. Plans have also been made for pilot plant testing in Canada of a process for producing ferromanganese directly from low-grade manganiferous materials near Woodstock, New Brunswick.

In May, 1955, the U.S. Interior Department told Congress that there was no need to extend the manganese stockpiling programme. Not only had the industry one whole year's supply available, but high-grade ores were plentiful on the market and new sources of supply had been discovered in Cuba and Mexico. A minerals purchase measure passed last year by the U.S. Congress was vetoed by President Eisenhower. A new measure before Congress seeks to provide for the payment of a production bonus to domestic producers and to set up a programme for the beneficiation of manganese ores. Its fortunes will be very closely followed by producers in exporting countries.

Since 1950, imports into the U.S. have exceeded consumption by some 3,500,000 s.tons, the difference being presumably accounted for by purchases for military stockpiles. On the other hand, study of the U.S. manganese ore statistics for 1955 leads to the significant conclusion that demand is again rising more rapidly than supply. The quantity consumed during 1955 reached an estimated 2,100,000 tons against 1,740,000 tons the previous year, while imports at an estimated 2,000,000 were lower by 166,000 tons than those for 1954. Despite the rising domestic production, it seems evident that if the American steel industry continues expanding, imports will require to be stepped up further to keep pace with demand.

Future Outlook

Provided the present high level of activity in the American and European steel industries is maintained, manganese ore should be in keen demand during 1956 and prices are likely to remain at higher levels than in 1955. In assessing the future outlook, the most uncertain element is whether the offerings from the U.S.S.R. will increase. Russia's own needs are enormous and are still expanding. Though production is being expanded with remarkable speed, it is therefore improbable that supplies of Russian ore will become available in pre-war quantities for many years to come. Despite one or two disquieting possibilities, the long-term outlook for manganese ore producers can thus be regarded as predominantly favourable.

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Chromium

PROGRESS in the fields of supersonic flight and guided missiles has created a need for materials capable of giving reliable service at extreme temperatures. It has also been found that the efficiency of both steam and gas turbines rises as operating temperatures and pressures are increased. Being an essential ingredient of high temperature materials, chromium is in growing demand.

In striking contrast to conditions in 1954, when U.S. imports and consumption both fell by over 30 per cent, producers of chromite commanded ready markets in 1955, due primarily to the high level of steel production in the U.S., the U.K. and Western Europe, but also to increased demand from the chemical and other user industries. In the U.S., which is by far the largest market for all grades, consumption rose from 914,000 s.tons in 1954 to the all-time record of 1,583,983 tons in 1955. Imports into the U.S. from all sources totalled 1,804,775 tons in 1955 compared with 1,470,000 tons in 1954.

Despite the improved demand, world production of chromite in 1955 (based on incomplete data for the first nine months) appears to have remained at approximately the same level as in 1954, when it was in the region of 3,250,000 s.tons.

Despite a reported increase in output, chrome mining in Turkey has undergone considerable vicissitudes since 1954, when termination of U.S. Government contracts and the high prices demanded by producers led to a curtailment of mining and an accumulation of unsold stocks.

Southern Rhodesian chrome producers anticipated poor results due to rail transport difficulties, but the year's output of 442,509 s.tons was slightly higher than in 1954. South Africa produced 542,000 tons, a fall of about 50,000 tons.

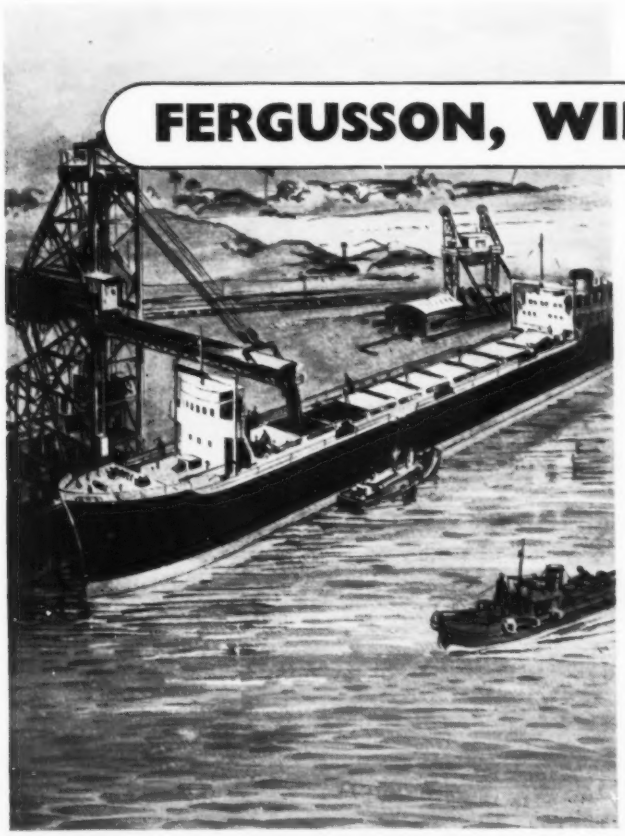
In Pakistan many new mining concessions have been granted. Approximately 30,000 tons was produced in 1955.

Cuban exports of Moa Bay and Yamaniguey Bay refractory grade lump chrome ore to the U.S.A., Canada and Europe during 1955 amounted to 123,000 s.tons. Production for the year was 81,000 tons, all of it by Minera Moa, S.A. and Minerales de Baracoa, S.A., who are conducting active exploration and development work to increase current ouput and bring new deposits into production.

Exports of chromite ore from the Philippines rose from 427,059 tons in 1954 to 594,936 tons in 1955. Improvements were completed at the Masinloc mine in Luzon owned by the Benguet Consolidated Mining Co. Palawan Consolidated Mining Co., formed in July, 1955, expects to begin shipping metallurgical grade ore in April/May, 1956.

The British Columbia and Yukon Chamber of Mines announced the discovery of a major chromite deposit in the Jennings Lake area, about 40 miles south of the Yukon border. A chromite deposit 30 miles west of Eshowe in Zululand may become one of the richest chrome mines in the world, according to Professor Jeppe of Witwatersrand University.

The outlook for chrome is governed mainly by the fortunes of the steel industry. Despite reduced activity by the automobile industry and other large users, there is at present no indication of a decline in steel production.



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Tungsten, Molybdenum and Vanadium

TUNGSTEN metal is used mainly as a constituent of extremely hard steel alloys, which absorb more than 90 per cent of the supply. Peace-time consumption is therefore governed by the level of activity in special steel production and by the cost of competitive metals.

World production is at present in the region of 39,000 tons of WO_3 contained in ores and concentrates. China produces about 40 per cent of the total output, Portugal 12 per cent, the U.S. 10 per cent and Bolivia eight per cent. Normally tungsten supplies come from a few efficient low-cost mines, but high demand and inflated prices attract many small marginal producers, who are quickly squeezed out during a recession.

Prices again fluctuated widely in 1955, but quotations remained generally at higher levels than in the previous year. Throughout the first quarter of 1956 supply and demand remained broadly in balance.

Production and Marketing

Portugal exported 4,476 tonnes of tungsten-bearing ores in 1955. Bolivian exports of wolfram at 2,437 tonnes remained at approximately the same level as in 1954. Korean tungsten continued to be offered at auction, and a chemical plant for producing higher grade concentrates was reported to be planned.

Consumption of tungsten concentrates in the U.S. approximately doubled in 1955, while U.S. domestic production of ores and concentrates rose to 7,500 s.tons compared with 6,500 tons in 1954. The General Services Administration has been purchasing domestic tungsten at a price of $63 a unit. A Bill extending this programme to 1958 was passed by Congress but was vetoed by President Eisenhower. Government purchases of domestic concentrates may therefore cease in June or July, 1956, when the money available has been spent.

G.S.A. has concluded an agreement with the O'Okiep Copper Company of South-West Africa to reduce the amount of tungsten supplied to the U.S. national stockpile. At the beginning of the Korean War G.S.A. contracted with the company for delivery of 120,000 s.ton units of tungsten up to March 31, 1958.

Deposits of tungsten ore are under investigation in a number of countries and several promising finds were reported during the year. Lepanto Consolidated Mining Co. has engaged a geologist specializing in tungsten ores to investigate deposits at an undisclosed site in the company's Philippine property. An occurrence of scheelite was found in Persia by a team of Persian and Belgian engineers. The find is situated in the Arak-Sultanabad region and the initial prospecting results are claimed to show very large reserves of tungsten with a WO_3 content of 2.5 per cent. A shipment has been reported from the wolfram deposits found towards the end of 1954 in the Ulu-Dag mountain area near Brussa, in Turkey, which are claimed to be among the largest in the world.

Most North American tungsten mines are operating in scheelite ore, which is said to be more costly than wolframite to mine and process. In October, 1955, it was announced that Burnt Hill Tungsten Mines, Limited had established the largest known deposit of wolframite tungsten on the North American continent, and planned to

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double the present 150-tons a day capacity of its tungsten mill at New Brunswick, Canada.

Despite the recession in the British and American motor car industries, steel production remains at a high level and seems likely to continue expanding. Despite these favourable conditions the structure of the tungsten market prevents any firm conclusion as to prices, but continued cycles of over-and under-production are to be expected. The possibility of additional U.S. supplies being forced on world markets through the cessation of the Domestic Tungsten Programme cannot entirely be excluded.

Though some time must elapse before civilian uses can fill the gap which would be created by a decline in armaments and strategic stockpiling, research now proceeding on new applications and improved machining techniques should lead to a broadening of demand, while larger supplies and lower prices would ease the competition from molybdenum and other alternative materials. A contract signed in November, 1955, between the Tungsten Institute in the U.S. and the Stanford Research Institute provides in part for study of high-temperature alloys in jet engines.

Molybdenum

Free World production and consumption of molybdenum rose to new peace-time peaks in 1955, due to greater usage in the alloying of iron and steel, and growing applications in chemical and other non-metallurgical fields.

The U.S. produces some 90 per cent of the total world supply and is also the largest consumer. In 1955 it produced 31,150 s.tons of contained molybdenum compared with 29,334 tons the previous year. Consumption soared from 12,350 tons in 1954 to 19,000 tons in 1955. Chile is the second largest producer, followed by Canada.

Throughout 1955 Climax Molybdenum maintained ore production at the record high level of nearly 30,000 tons per day. A four-year expansion programme costing $34,000,000 was completed during the year, but milling facilities are now being further expanded by the addition of a mill unit designed either to increase recovery of molybdenum disulphide concentrate by about three per cent with no increase in tonnage, or to increase production by about 2,000 tons per year on the present recovery basis. This project is scheduled for completion towards the end of 1956 and should materially improve the supply position.

Another major source of supply is foreshadowed by the announcement that Anaconda will ask the Chilean Government to authorize an investment plan for installation of equipment to recover molybdenum from the copper ore at Chuquicamata. The opening of the San Manuel mine, Arizona, will raise by-product production by increasing amounts in the next two or three years. In January-September, 1955, the Moybdenite Corporation of Canada exported 67 tons of molybdenum in concentrates to the U.S. This company's milling capacity is being expanded to 600 tons a day.

With production expanding and increasing consumption the outlook for molybdenum seems hightly favourable.

Vanadium

The U.S. produces more than half the total world supply of vanadium and is the largest consumer, but statistics regarding this metal are withheld by the government for security reasons. The South-West Africa Company is the only non-dollar producer of vanadium, and gives priority to U.K. consumers. In February, 1956, the company stated that in the past seven months 200 tons more vanadium had been delivered than in the same previous period.

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Niobium and Tantalum

By ROBERT A. MACKAY, D.Sc.

THE past year has seen changes in the market position of niobium which have caused considerable concern to all producers and have been catastrophic for some of the smaller ones. To see what lies behind this, a review of niobium markets for some time past seems desirable.

Although the metal has been known for a long time it is commercially a relatively new one and has had an interesting rise to prominence. About mid-way between the wars it was of mineralogical interest only, though as such it was well known in Nigerian tin concentrates where it had a certain nuisance value. Uses gradually developed for it, but it was still won in quite small tonnages and only commanded a price relating to a relatively unimportant by-product. Other uses arose during the war when pressure was applied to achieve increased production which lead to a peak year in Nigeria—which has always been the main producer—of about 2,000 tons a year, but this peak production was obtained mainly from old tailings and dumps. Prices were not raised appreciably as the result of this special demand.

Consequences of U.S. Price Boost

After the war demand again became brisker and prices started to rise substantially but not spectacularly. The price rose from 55s. a unit in 1946 to 235s. a unit in 1951, and the spectacular rise came in May, 1952, when the United States government announced a big increase accompanied by a 100 per cent incentive bonus. The price then became 320s. a unit of joint $Nb_2O_5-Ta_2O_5$, plus a further 100 per cent bonus of 320s. The purpose behind this was to fill a 15,000,000 lb. stockpile and the undertaking given was to continue purchasing until the end of 1956, or until the stockpile was filled, whichever was the sooner. It might be noted that this price was equivalent to one of about £2,200 a l.ton for 70 per cent joint pentoxide concentrate (i.e. 70 per cent $Ta_2O_5+Nb_2O_5$).

This programme had two effects : It stimulated the search for niobium, and drove consumers to using less effective but cheaper substitutes for most of their purposes. In March last year the stockpile was stated to have reached 8,750,000 lb. and in May the buying stopped when it was announced that the quantity received, plus forward commitments equalled the desired quota of 7,500 s.tons.

The producers having been stimulated to greater production and the consumers driven away, the state of uncertainty was produced which still prevails, although it appears to be gradually resolving itself. The best thing that came out of this peculiar situation is that it has now been established beyond any doubt that the producers can supply for at least a decade to meet all foreseeable demands—a matter that was in much doubt before the American programme started.

Nigeria continues to be the world's main producer of niobium, all in the form of columbite, but other potential sources for the future, mainly as pyrochlore, are well known largely as the result of the bonus; some of these sources lie in North America and the fact that this continent now has such potential sources is likely to have reassured potential users of the security attaching to supply, and so may now, it is hoped, stimulate an expansion by such users. It is clear that before this recent period of more intensive exploration than in the past, the lack of the element in North America had made some of those who are in a position to consume it, as well as governments in that country, apprehensive of the minerals from a strategic point of view.

The present trouble lies in the fact that the stimulus provided by the bonus led to too high a price for the element to be used for certain of the processes for which it is well suited, and the consumption of the world fell, an extremely high proportion of all production merely going to stockpiling. Thus on the close of the stockpile a state of great over-production existed, and it is only by research and development by large companies in a position to do this that consumption can be brought to a point where existing and potential producers can regularly and confidently sell their product. It is known that certain powerful organizations are not asleep in this matter.

It should also be added that as far as it is possible to prognosticate the future, it is thought that the price should remain somewhere in the range at which parcels have changed hands recently. Many of the anticipated uses are of a nature that call for a reasonably low price. This again leading producers seem to realize and do not appear to be unduly concerned. Of course, any prognostication of this nature does not take into account the possibility of new uses at a higher price, but these are not in sight.

Niobium was mainly used before the "denial" price set in as a stabilizer for certain types of stainless steel, and as an additive to certain high temperature resistant alloys. Tantalum will also act in this way as a stabilizer more cheaply than niobium, but in the opinion of some people, not so cleanly or satisfactorily. It has recently been stated that it is likely to be used in atomic energy programmes for the canning of rods to be inserted in piles, or possibly for pipes to carry molten sodium through the reactor. Such a use would not be likely to be a high tonnage one but should certainly draw attention to its properties of strength, anti-corrosion and heat resistance, etc.

Growing Supply of Columbite from Primary Sources

The main change that has taken place over the year, irrespective of price considerations, has been the growing proportion of columbite which has been produced from primary sources. Two large sources of this nature are at present being worked in Nigeria, one by Amalgamated Tin Mines of Nigeria Ltd. and the other by Tin and Associated Minerals Ltd. In both cases the columbite occurs as fine crystals and is an essential mineral of the granite. Much of the granite contains columbite in this way, but at present it is only regarded as ore in those places where the granite is weathered completely so that it can be worked by water without crushing. The deposits are large ones; for example, Tin and Associated Minerals published that they already had about 20,000,000 tons of ore at over 2 lb. of columbite to the cu. yd., and it can be assumed that this is only part of the total reserves which may be developed.

Thus the ratio of columbite won as the main mineral of the operation to that won as a by-product of tin has risen substantially during the year, and given a reasonable demand, it is likely to rise still further.

Pyrochlore is in a very different catagory to columbite as a potential source of niobium. Only Scandinavia has produced any so far and it is understood that their deposit approaches the border line of payability at existing prices, and in any case would not, under present conditions, be likely to expand.

No important new deposits of pyrochlore have been discovered during the year although work has continued on a number of the larger ones. The Nigerian government have continued research work of a mineralogical nature on the large deposit at Kaffo where the mineral occurs in a hard granite to the extent of about half per cent (0.3 per cent Nb_2O_5) and is accompanied by uranium. This most peculiar granite of which there is many hundreds of thousands of tons per foot of depth, carries a few per cent of cryolite. Were this Kaffo deposit ever to be worked, the pyrochlore would be the main mineral with very useful by-products in the form of the cryolite and the uranium. Research by the Tororo Exploration Co. (in which the Uganda Development Corporation and Frobisher Ltd. are associated) has also continued on ore mineral dressing problems mainly. Here the main mineral is apatite and the workability of the deposit depends primarily on phosphate economics. 200,000,000 tons of ore carrying about a quarter per cent Nb_2O_5 were proved a few years ago. The ore consists of a soil derived from calcium carbonate rock.

Work in the exploration and testing stage has also continued at Mpanda in Tanganyika and Mrimba in Kenya, but at Chilwa in Nyasaland work was suspended late last year following the price fall. The work at Mpanda is in the hands of Billiton and the Colonial Development Corporation and that in Nyasaland was being conducted by a member of the London Tin Corporation. Although there is undoubtedly a very large amount of niobium in these carbonatites of East Africa, and although it is clear that there are places where the concentration is higher than average, there is more work to be done before it can be stated that they do constitute part of the world's reserves at present existing prices. For even some of them to be worked it is thought that the demand for niobium would have to rise very sharply indeed. Apart from the carbonatites being investigated, many other occurrences are known to exist in Africa.

More work has gone on also in testing the pyrochlore occurrences in Canada, but it is not known to the writer whether the content of mineral in these bodies can stand up to present prices. Their importance, however, would seem to lie in the insurance factor to the American continent that they need never be short of the element even though it might be at an enhanced price. This much the Canada exploration seems already to have proved. In addition, columbite continues to be found in small unimportant amounts from many pegmatitic sources throughout the world such as British Guiana, Australia, Uganda and the Congo.

The Outlook

In conclusion, the year has seen the market situation for columbite deteriorating seriously, although in the opinion of many this is only temporary, for a new metal with such potentialities will inevitably find its uses. On long-term, the outstanding development of the year is that it can now be said with confidence that the world's reserves could meet even an expanded demand for decades to come—a point on which a very short time ago there was much room for doubt.

As regards tantalum there is little that can be said. The sources continue to be the world's pegmatites, most of which constitute small, scattered, erratic and problematical occurrences. Naturally, the very large price—since the stockpile programme still continues for this element—has stimulated production, but it is not known to the writer whether it has led to the discovery of any important orebody. It will be interesting to see whether the continuance of the programme does lead to any steadier, low grade source of this tantalizing metal.

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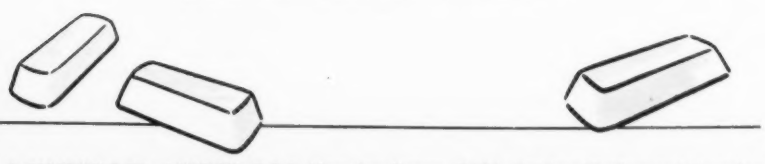

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In 1954 the Free World output of 14,300 s.tons set up a new record for the fifth consecutive year. Production remained at a high level in 1955, being estimated at 14,000 tons. After declining in 1954, due to the lower volume of steel production, consumption was greatly increased last year. U.S. consumption rose to 4,820 tons, a gain of 33 per cent over 1954, while imports at approximately 8,000 tons were 12 per cent higher than in 1954 (7,114 tons).

In 1954 Africa supplied 83½ per cent, of the world output of cobalt, Canada nine per cent, and the U.S. 7½ per cent.

The temporary decline in demand led to reduced exports by the world's largest producer, the Belgian Congo, which shipped 4,980 tonnes of cobalt granules and 7,141 tonnes of cobalt alloy (5,052 and 8,056 tonnes respectively in 1954).

In Northern Rhodesia cobalt is derived as a by-product from the refining of copper ores at Nkana by the Rhokana Corporation. During the financial year ended June 30, 1955, Rhokana produced 871 tons of cobalt metal. Chibuluma Mines started producing copper-cobalt ore at its mine near Nkana in October, 1955. Its new flotation concentrator was to be officially opened in May, 1956. The cobalt concentrate will be treated near Ndola and recovery will ultimately reach 250 tons of cobalt metal annually.

The Canadian output of cobalt in 1955 is estimated at 1,499 s.tons, compared with 1,176 tons in 1954. International Nickel's deliveries of cobalt rose to 818 s.tons from 658 tons in 1954. Among the year's most notable developments was the initial operation of the new pilot plant and cobalt-production unit of Sheritt Gordon Mines, Ltd., Fort Saskatchewan, Alberta. This plant treats a nickel-copper concentrate produced by the company at Lynn Lake, Manitoba, and will be capable of producing 150 tons of cobalt metal a year.

The U.S. output of cobalt metal in January-October, 1955, totalled 1,489 s.tons, being 25 per cent higher than in the corresponding period of 1954. A major factor in this increase was the rising production of the Calera Mining Co., which produces cobalt concentrates from ore mined in the Blackbird district of Idaho. By the end of 1955 this company's Garfield (Utah) refinery was approaching capacity operation.

The General Services Administration of the U.S. Government is financing two very large projects for work on the laterite deposits of Cuba, which are believed to be the world's largest reserves of cobalt. Existing and contemplated nickel-extraction plants in Cuba have a potential recovery approaching 2,500 tons annually from this source.

With adequate supplies available and new plants scheduled for completion within the next few years, the cobalt industry is well placed to meet the growing demand from producers of high temperature materials and magnet steels. Equally, it would appear that excess industrial usage is expanding rapidly enough to compensate very largely for any reduction in Government demand resulting from the completion or curtailment of stockpiling programmes.

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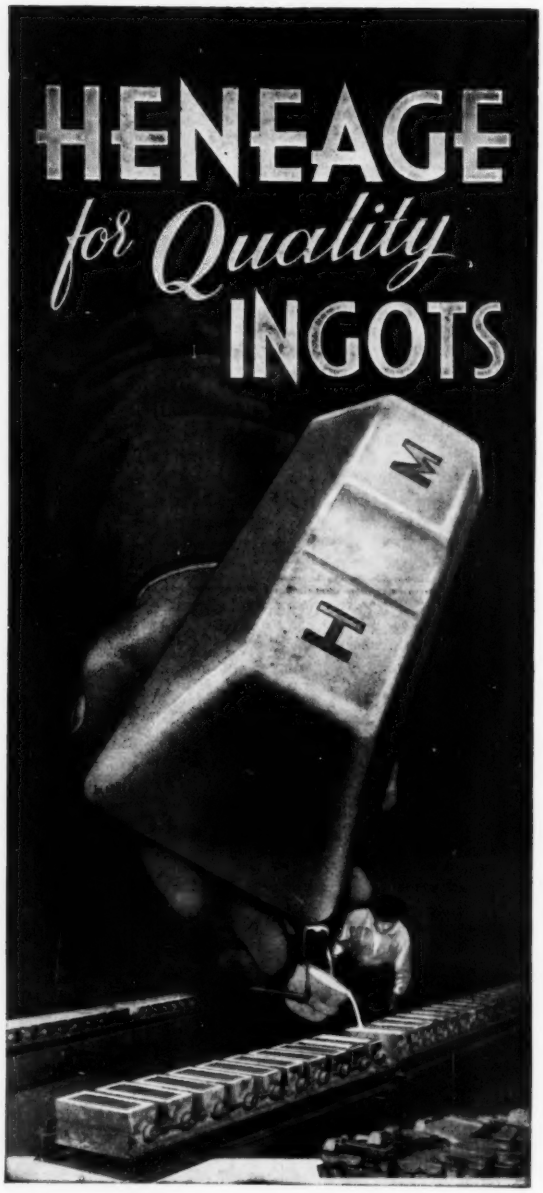

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Rising Ore Supplies

The supply of lithium-bearing minerals has been radically changed in recent years by the development of very large deposits, notably in Canada and Southern Rhodesia. In 1955, Southern Rhodesia produced 82,000 tons of lithium ores valued at £328,442, compared with 54,050 tons (value £282,020) in 1954. Almost the whole of this output was from the Victoria district. Rhodesian ores will be processed at San Antonio, Texas, by American Lithium Chemicals Inc., a company owned jointly by the American Potash and Chemical Corporation and Bikita Minerals Ltd. Production was expected to start early in 1956. A development programme has been started by Bikita Minerals to step up their output to 90,000 tons.

In Canada nearly 100 companies or individuals were reported to be searching for lithium. The most advanced lithium operation is that of Quebec Lithium, which has a contract with the Lithium Corporation of America for delivery of 165 tons of lithium oxide daily for five years from the LaCorne area of Quebec. Lithium Corporation has built a $7,000,000 plant in North Carolina to handle the production from Quebec Lithium and from its own Kings Mountain mine.

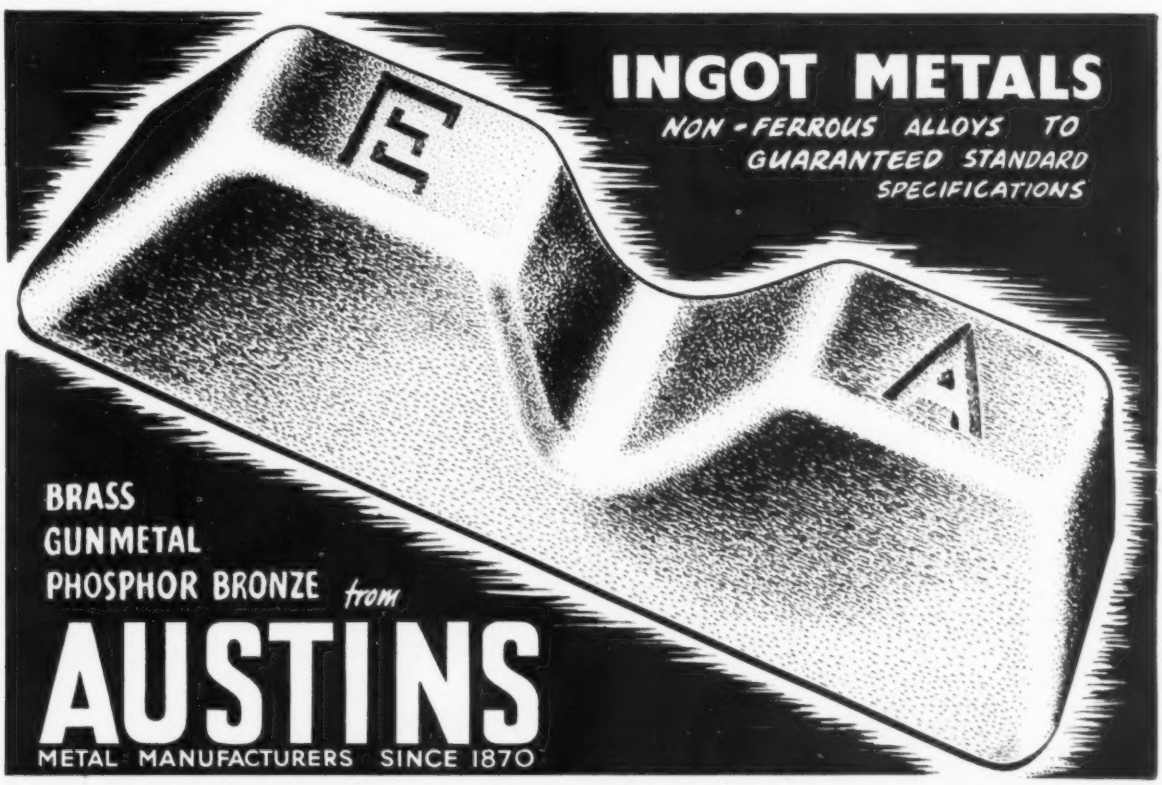
The present situation in the U.S.—by far the largest producer and consumer of lithium minerals—appears to be obscure. Current production capacity in terms of lithium carbonate is placed at between 10,000 and 12,500 tons annually, but consumption during 1955 was estimated at under 4,500 tons. The difference between these two figures may be accounted for by U.S. Government purchases.

The production of lithium carbonate is to be undertaken by Géomines in a pilot plant at Brussels.

Military and Industrial Uses

It has been widely stated that lithium is a key material in the production of hydrogen bombs. Because of its high neutron capture cross section, the metal has been investigated as a possible shielding device for fission reactors. At a meeting of the Manufacturing Chemists' Association in the U.S., it was stated that lithium compounds with hydrogen had been found to be a potential source of power for types of engines other than those in jet planes and missiles.

Industrially, lithium continues to find its largest outlets in ceramics, greases and the chemical field, with promise of applications in air conditioning and refrigeration. A rapidly increasing demand for lithium-bearing enamels for aluminium is reported from the U.S. Price reductions of 10 per cent by the American Potash and Chemical Corporation for the 1956 contract year are expected to stimulate industrial usage. The potential world demand for lithium carbonate has been estimated at 10,000 tons a year.



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Beryllium

AFTER a period of apparent shortage, which lasted into 1953, the production of beryllium caught up with demand during 1954 and the supply position became much easier. This situation was attributable largely to the success achieved in expanding the free world production of beryllium ores, notably in Brazil and Southern Rhodesia. As a result of the changed position world production declined by 32 per cent in 1954 from the record of 9,300 tons set up the previous year. World stocks rose to the highest level in history. In 1955 the demand for beryllium resumed its upward trend, sales in the U.S. reaching an all-time peak. The improved supply position has enabled the beryllium industry to embark upon ambitious programmes for expanding existing markets and opening up new ones.

Southern Rhodesia produced 963 tons of beryllium in 1955. The U.S. domestic production fell to 650 s.tons. The Union of South Africa and South-West Africa produced 371 tons and 471 tons respectively.

Because of its remarkably low capture cross section for neutrons and X-rays, beryllium is among the best structural and canning materials for reactors. Where weight is not important, however, much cheaper materials are available to do the same job in reactors. It is in atomic aircraft propulsion systems that beryllium's greatest nuclear outlet is foreseen.

In September, 1955, the U.S. Atomic Energy Commission invited private industry to take over the responsibility of supplying it with beryllium. Proposals were invited for the supply of up to 5,000 tons of the metal over a five-year period. The A.E.C.'s beryllium requirements were formerly met from the production of a Government-owned plant at Luckey, Ohio, which is operated for the Commission by Brush Beryllium Co., of Cleveland. The other U.S. producer of the metal is the Beryllium Corporation of Reading, Pa. In the second half of 1955, Government maintenance-of-plant contracts were accorded to both these companies. Deliveries under the new procurement are required at the earliest practical date by which suppliers can reach the proposed production levels. If a proposal is accepted, the Commission will put the Luckey plant on a standby basis.

Technological Progress

Industrially, beryllium's most important use is as an alloying agent to harden and strengthen other materials, chiefly copper. Much progress has been made during the past two years both technically and in the expansion of fabricating facilities. The Beryllium Corporation has announced the virtual completion of a major expansion programme that will significantly increase the quantity, quality and variety of beryllium copper wrought products.

Progress was also made during the year in the development of new applications. New die techniques claimed to cut aircraft forging lead time by three-quarters were developed by the Columbus Division of North American Aviation, the most notable feature of the tooling system being the use of beryllium copper dies.

Beryllium appears to be approaching the stage when increased fabricating facilities, supported by improved technological know-how and based on an assured supply of raw materials, might lead to further expansion. The price remains very firm, quotations being difficult to obtain.

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Radio-Active Minerals

By C. F. DAVIDSON, O.B.E., D.Sc., F.R.S.E., M.I.M.M.

FOR rather more than a decade geologists have been busy not only in the search for uranium deposits in the field, but also in the study of the fundamental geochemistry of uranium in the laboratory. Whilst the activities of the field men have unavoidably been conducted in a blaze of publicity, the precise details of their discoveries have usually been hidden by a blanket of security. The work of the laboratory workers, on the other hand, has met with little public comment, though their conclusions have been published openly in the scientific journals. Now the events of the last year have demonstrated the immense value of the "back-room" activities, and two great uranium provinces, one rapidly coming into production and the other yet in a very early phase of exploration, stand as monuments to geochemical research and induction.

First, the Blind River field in Ontario was discovered by Franc. Joubin by his acceptance of the conclusion that the weathered outcrop of a uraniferous pyritic orebody, although noticeably radioactive, might be found to be quite devoid of uranium on chemical analysis. Briefly, the uranium is leached away at the surface in the sulphuric acid formed as the pyrite oxidizes, whilst the radioactive daughter elements are for the most part fixed in the products of weathering; and only from fresh rock, procured by diamond drilling or otherwise, can the prospect be evaluated.

Second, the discovery of a new field of rich uranium-bearing lignite in South Dakota derives from laboratory researches on the adsorption of uranium by coals, leading to the conclusion that where coaly strata underlie a permeable, feebly uraniferous, formation, the topmost coal seam will retain the leached-out uranium brought to it by downward percolating ground-waters.

Canadian Developments

The rapidity with which the exploration of the Blind River field has been conducted will long be a highlight of mining history. In 1952 some 36 claims were staked near the north shore of Lake Huron, in a horizon of iron-stained quartz conglomerates with pronounced radio-activity but low uranium values. In April, 1953, drilling began—and in May payable ore was intersected. Immediate prospecting, undertaken with the aid of a Geological Survey map showing the outcrop of the conglomerate reef, resulted in 1,400 claims being staked one day in July. The news broke, one of Canada's greater prospecting rushes followed, and before winter set in 14,000 claims were registered.

By the autumn of 1955 metallurgical problems had been solved and the first mine, Pronto, was in production with a 1,500 ton mill. By the end of the year Algom and Consolidated Denison had in course of construction two 3,000 ton mills and one of 5,700 tons capacity respectively, and negotiations for production from other properties were in progress. Government regulations forbid the announcement of ore reserves after the completion of contract negotiations; but to January, 1956, about 40,000,000 tons of ore had been reported prior to this security closure, the ore carrying 0.10-0.124 per cent U_3O_8 in reef widths of around 14 ft. Many other properties are in course of development, and it is by no means impossible that the total potentiality of the field could exceed 500,000 tons of uranium metal.

Elsewhere in Canada new properties have been developed with equal rapidity. Scarcely three years from the discovery of the prospect, production from a $20,000,000 plant at Gunnar in the Beaverlodge district of North Saskatchewan began last autumn, milling 1,600 tons daily. The orebody here is a giant stock-work of thin pitchblende veins in soda-granite and gneiss, reported to be 1,400 ft. long and 600 ft. across. It is estimated that $100,000,000 production will be available from opencast working; and a shaft for underground mining should be completed to 1,200 ft. by the spring of 1956. At Lorado, also in the Beaverlodge area, there is planned a 625 ton custom mill for some smaller high-grade mines working pitchblende lodes; and at Bicroft in Ontario a 1,000 ton mill is being erected to treat uraninite-uranothorite ore from complex veins.

During the latter part of 1954 and in 1955 contracts placed by the Canadian Government with these companies, for delivery of concentrate before 1962, totalled over $550,000,000. Further contracts have since been placed, bringing the total to $700,000,000, from plant with a daily capacity of 19,000 tons, principally in the Blind River field. In addition, the Government-owned Eldorado operation has itself launched a major expansion programme, raising the daily milling rate at the rich Ace mine at Beaverlodge from 700 to 2,100 tons; whilst the old-established property at Great Bear Lake continues as a significant producer.

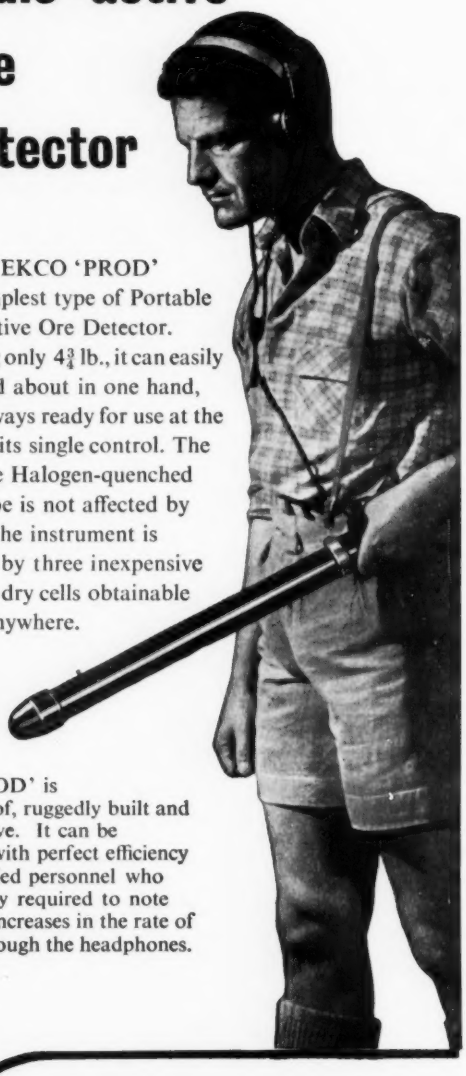
American Progress

In the United States most of the domestic production continues to come from the Colorado Plateau; but in addition to the long-known carnotite deposits, primary orebodies with unoxidized uraninite and copper sulphides have lately become increasingly important. Both types of mineralization are disseminated throughout flat-lying sandstones and less commonly shales and limestones, the age of which is principally Jurassic-Cretaceous but ranges from Lower Palaeozoic to Mid-Tertiary. In the earlier operations most of the production came from close on a thousand little mines, each with a few thousand tons of ore carrying 0.1-0.5 per cent U_3O_8; but later work has revealed numerous deposits with more than 100,000 tons and at least one in the million ton class. It is now estimated that four-fifths of the known reserves are in ore deposits larger than 50,000 tons.

The most notable recent discoveries, referred to above, have been of lignite and carbonaceous shale carrying more than 0.1 per cent uranium, in strata of Late Cretaceous-Miocene age at widely separated localities in Wyoming and the Dakotas. In the Riley Pass area, Harding County, South Dakota, about 440 acres are underlain by a lignite bed 1.3 ft. thick and carrying 0.76 per cent uranium, some samples from the area also containing as much as 0.5 per cent molybdenum and 0.9 per cent arsenic. Similar but smaller deposits have been found in the Slim Buttes region of South Dakota and the Killdeer Mountain area of North Dakota. The uranium has apparently been introduced into the coal by ground-water solutions percolating downwards from mildly radioactive volcanic tuffs, and where the amount available exceeds that tenable by the organic matter, autunite, torbernite and zeunerite occur along the cleat and bedding planes.

Further discoveries likely to become of increasing importance have been made in Karnes County, Southern Texas. Here the mineralization is secondary, in unconsolidated tuffs and sands, and is associated with large amounts of copper and arsenic.

A new radio-active ore detector



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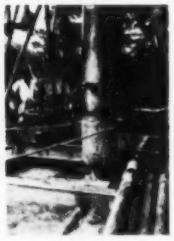

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It was announced in April that "private uranium activities in the United States have a value of over $100,000,000 per year." The reserves of ore at present in sight may be exhausted in the next five to ten years; but a statement by Mr. Jesse Johnson, Director of the Raw Materials Division of the U.S. Atomic Energy Commission, forecasts that "on the basis of geological probability, hundreds of thousand of tons of uranium in millions of tons of ore remain to be discovered in the sedimentary deposits of our western states."

Activities in Australia

The oldest of the several uranium properties in Australia, the Radium Hill mine owned by the South Australian Government, began full-scale operation early in the year, and the chemical plant at Port Pirie, where the concentrates are treated, was completed in August. This operation is of unusual technical interest, for it is the only one on this side of the Iron Curtain where the ore (a uraniferous iron titanate) is highly refractory, requiring prolonged treatment with strong acid at boiling point to bring the uranium into solution. An announcement in August revealed that the cost of establishing the mine and treatment plant was £A6,800,000, of which rather more than half was provided by the British and American Governments. The South Australian authorities have since invited applications from mining companies interested in working a geologically similar occurrence at Mount Victoria Hut, 80 miles from Radium Hill.

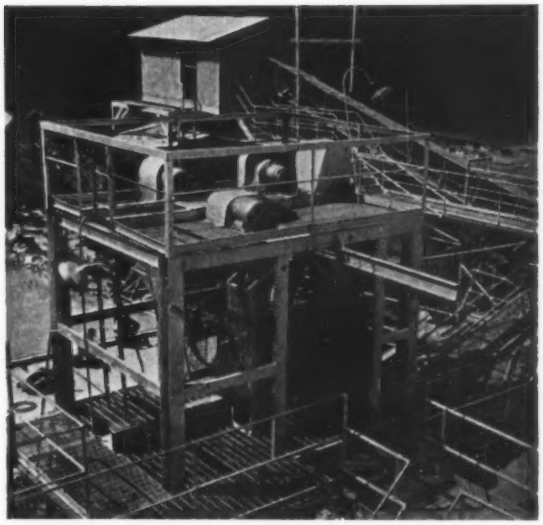
The other Australian mine which is well established, at Rum Jungle in the Northern Territory, is operated for the Atomic Energy Board by the Zinc Corporation. The ore is a highly mineralized shale bearing uraninite and copper sulphides; and the copper, of which the first shipment was made in November, may well become a remunerative by-product.

Of the many prospects undergoing exploration, the most interesting appear to be the Mary Kathleen property 50 miles from Cloncurry, which was found in June, 1954. The mineralization here is of a unique kind, consisting of very fine-grained uraninite, coarse allanite, much apatite, and a new rare-earth borosilicate named stillwellite, all associated with an assemblage of calc-silicates of skarn type. The deposit is clearly one of the richest sources of rare earths in the world, and its potentiality as a uranium producer has been thoroughly explored throughout the year by the Rio Tinto Company in association with Australasian Oil Exploration Ltd. It has been announced that Rio Tinto will proceed with plans to develop this area at an estimated cost of £7,250,000 and that the Australian Atomic Energy Board will in due course sell in Britain concentrates to the value of £A40,000,000. Exploration at other prospects in the Mt. Isa-Cloncurry region is much less advanced, and as elsewhere in Australia the work done in some instances seem inadequate to justify the statments on ore reserves that have been made.

Much activity is also being shown in the Alligator River region in the Northern Territory, to the south of Rum Jungle. Here the Atlas Corporation of America, in association with the North Australian Uranium Company, is a dominant figure in the field. It is evident that there are many small potential producers, but the marketing of their output will in large part depend on whether one or more of the properties proves to be sufficiently large to merit the high capital expenditure that erection of a treatment plant entails.

The South African Contribution

The output of uranium concentrates from the gold ores of the Witwatersrand and the Orange Free State has now become the largest by-product industry that mining has ever seen. Contracts have been signed between the South African Atomic Energy Board and 26 mining companies to provide ore and slimes for treatment in 15 extraction plants, at an ultimate capital expenditure of around £65,000,000; and the value of uranium production is expected to rise to about £53,000,000 yearly. From the 22 companies that are members of the Chamber of Mines there was in 1955 an estimated uranium profit, before deduction, of around £16,000,000.



Uranium ore being carried by conveyors through intricate sampling equipment on the Colorado Plateau

The only other important uranium producer in Africa is the long established Shinkolobwe mine in the Belgian Congo. Elsewhere there has been a good deal of prospecting, but no discoveries of note have been reported. Perhaps it is not altogether coincidence that the countries which have had the greatest successes in their domestic exploration, Canada and the United States, are those where prospecting operations are least hampered by security restrictions. Even to-day there are African territories where one breaks the law by switching on a Geiger counter.

Future Supply and Demand

A welcome lifting of some of the security curtains was evident during the past year. At the Centenary Congress of the Société de l'Industrie Minérale in June, the French Commissariat à l'Energie Atomique made public much information on the results of uranium prospecting in France and its Colonies; and at the United Nations "Atoms for Peace" Conference at Geneva in August a vast number of scientific papers were delivered, at least by title. Since the mass of contributions swamped the reproduction facilities the texts of many of the geological papers were unfortunately not available even to the official delegates; and their formal publication, promised early in 1956, is therefore eagerly awaited. One of the more encouraging features of the Geneva meeting was the willingness of Russian geologists to discuss with their western colleagues the fundamental science of uranium mineralization.

To the mining industry the main interest of the Geneva Conference is that it marks the dividing line between the search for uranium and a future search for cheap uranium. The known uranium resources of the Free World, available at a "moderate" price of around £4 per pound of oxide

contained in high-grade concentrate, are now not less than 1,000,000 tons. If one were to raise the price to £10-£15 enormous low-grade resources, in shales, phosphate rocks, and radioactive granites, could come into production. Since the various estimates of uranium requirements are in the range 10,000-20,000 tons per year, it is evident that known resources are adequate to meet the foreseeable demands for a long time ahead, provided production capacity can be built up quickly enough; and considering the rate at which new discoveries are being made and the large areas that are relatively unexplored there seems little likelihood of the low-grade resources being drawn upon. The probability of medium-grade refractory ores finding a market has also become increasingly remote. The "have-not" nations, in which the British Colonies and the Central African Federation must be included, will no doubt augment their efforts to find domestic sources free from political vagaries; but in countries with significant reserves the future emphasis will clearly be on low-cost output, uranium production becoming as competitive as any other branch of the mining industry.

In March, 1956, President Eisenhower sanctioned the lease or sale of 40,000 kg. of Uranium 235 (more than 39 tons) for the peaceful development of atomic energy at home and abroad. It is estimated that about 2,000,000 tons of uranium ore has to be refined to produce approximately 50 tons of U235. Theoretically this represents an electric power capacity of about 4,000,000 kW. The view has been expressed that President Eisenhower's action probably means broadening the U.S. Government programme for uranium ores and its extension beyond 1962. The release of this large quantity of Uranium 235 should stimulate nuclear engineering developments for peaceful uses in many parts of the Free World, including the smaller nations.

Britain had previously announced her intention of contributing enriched Uranium 235 to the International Atomic Energy Authority.

Thorium and Heavy Water

No notable new developments in thorium production have been reported in 1955. The present world output of monazite, totalling around 10,000 tons of mineral yearly, is derived mainly from dredging operations in the valleys of Idaho, from beach-sand workings in Florida, Brazil and Travancore, and from a lode-mining operation in Cape Province, South Africa. Increasing interest is being shown in thorite-bearing residues from the Nigerian tinfields; but since there is no long-term guaranteed price for thorium, as there is for uranium, development of many possible sources is retarded by lack of knowledge of future markets. The biggest potential reserves lie in some of the new uranium plants in Canada. Here, although the thorium content of the ores is very low, the cost of mining, reduction and leaching is borne by the uranium; and, should an adequate market arise, a large output of thorium (perhaps doubling the present world production) could probably be achieved by the treatment of the waste liquors from which the uranium has been extracted. Such a procedure would be contingent upon the development of ion exchange resins with a high retentivity of thorium.

In January, 1956, it was announced that the U.K. Atomic Energy Authority had decided to withdraw from the project to utilize geothermal steam for the manufacture of heavy water at Wairakei in New Zealand, since the cost of plant construction was likely to be much higher than the original estimates. The New Zealand Government is to continue with a programme to develop the fumaroles as a source of electrical power.

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In the U.K., where zirconium is produced by Murex Ltd. and has been available to industry for a number of years, development has been restricted by processing costs, which are at present high. In the U.S. the difficulties arising from the cost factor were overcome by a long-term contract placed with the Carborundum Metals Co. to produce zirconium in quantity for the A.E.C. Yet as recently as 1954 the U.S. output was only of the order of 100 tons and it is doubtful whether this tonnage was very greatly increased in 1955. Zirconium metal is also produced in France, but on a very limited scale.

In 1948, when the A.E.C. became interested in zirconium, the U.S. Bureau of Mines had a pilot plant in operation in Albany, Oregon, which was capable of producing about 1½ s.tons of sponge metal a year. This plant was later enlarged to the point where more than 140 tons of zirconium sponge was produced in a single year. The process employed was the Kroll process, first used for titanium metal, which was adapted to the volume output of zirconium sponge by Dr. W. J. Kroll and his co-workers at the Bureau of Mines laboratories. In addition, the Bureau began producing hafnium, a metal that occurs with zirconium and must be removed before the latter is suitable for use in nuclear applications. The A.E.C. soon discovered important uses for hafnium.

Private industry in the U.S. began producing zirconium and hafnium by the Kroll process in 1953 and with assistance from the Bureau of Mines its capacity for both metals was rapidly increased. Early in 1955 the Bureau shut down the Albany plant at the direction of A.E.C., who requested, however, that the equipment should so be maintained as to permit the resumption of production at three months' notice.

On August 25, 1955, the A.E.C. solicited proposals for the establishment of facilities to produce 1,000 tons of zirconium over a five-year period or 600 tons over three years to meet the requirements of the expanded reactor programme. As a result of this offer ten proposals were received. Pending the construction of these facilities, it was found necessary to supply interim requirements which could not be met from the stockpile and from the production of the Carborundum Metals Company. The ten firms which submitted proposals were therefore asked for expressions of interest in operating the Albany plant, which is being restored to operating condition at A.E.C.'s request.

Almost all the zirconium of commerce comes from two minerals, zircon and baddleyite, which are widely distributed. The Free World's known ore resources are capable of satisfying all requirements that can be foreseen.

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Germanium

In radar and similar applications germanium crystals are used for the rectification of microwaves. Germanium transistors for operation at very high frequencies are now available, while germanium silicon alloys allow high temperature operation. An electric train fitted experimentally with a germanium rectifier is undergoing trials in London.

In the U.S. recovery of germanium from the residues of zinc ores may be increased by methods developed by the Bureau of Mines. A germanium oxide process is reported to have been successfully worked out by the Darmond Mining and Smelting Corporation, which mines ores containing from two to ten lb. of germanium per ton.

Co-operation between Government and commercial laboratories in the U.K. has lead to the economic recovery of germanium from flue dusts and the production therefrom of high purity material for use in transistors and rectifiers.

A method of obtaining germanium on a semi-works scale has been devised in Poland.

At Kolwezi, Upper Katanga, Belgian Congo, a small plant for the recovery and treatment of lead, cadmium and germanium contained in the dust from water jacket furnaces of Union Minière came into operation in January, 1955. The material is shipped to the Olen works of Société Génerale Métallurgique de Hoboken, of Antwerp, who are building a new plant for the production of high purity germanium by a process of their own development.

Selenium

Selenium rectifiers have many highly specialized applications and demand for this semi-metal exceeds supplies. Selenium is extensively employed in the manufacture of coloured glassware and is also required for photo-electric cells, as a vulcanizing agent, and for metallurgical purposes. The world supply comes mainly from anode muds produced in the electrolytic refining of blister copper. The largest producers are the U.S. and Canada, the former being also an importer of selenium. There is a very limited production in Northern Rhodesia, Australia, Mexico, Japan, and various European countries. The U.K. supply comes mainly from Canada, which produces about 175 s.tons a year.

U.S. production in 1955 is estimated at 412 tons against 420 tons the previous year, having been substantially curtailed as a result of strikes at domestic copper mines, thus aggravating the acute world shortage. In the U.K. the nominal price of selenium was raised in February, 1956, to 112s. a lb., which compares with 35s. 9d. at end 1954.

An accelerated search for new sources was begun in the Western States last year. The first discovery of selenium in economic quantities as a primary deposit was announced from Wyoming.

No immediate increase in world supplies seems probable. With the demand for selenium rectifiers continually expanding, selenium seems likely to remain scarce this year.

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Quicksilver

THE heavy increase in all types of scientific and industrial control instruments has led to new and important uses for quicksilver. Large U.S. Government purchases during 1954 suggested the possibility that this metal might also have nuclear importance, but no evidence to support this theory was forthcoming at the " Atoms for Peace " Conference in 1955.

World production is trending upward, an output of about 6,600 s.tons being recorded for 1954. In the absence of concerted action by producers increased supplies, coupled with a heavy decline in U.S. purchases, resulted in a buyers' market in 1955. Prices, which reached their peak at the end of 1954, drifted downwards throughout 1955 to around £89 per flask ex London warehouse at the end of the year. This tendency continued during the early part of 1956.

Italian and Spanish Production

Owing to the complete cessation of U.S. buying, together with a substantial reduction of British purchases, Italian exports of quicksilver fell away sharply in 1955, shipments during January - June amounting to only 524 tons, compared with 1,582 tons in the corresponding period of 1954. On the other hand, Italian production of metal has shown little variation, remaining consistently in the region of 1,700 - 1,800 tons a year.

The Spanish mines of Almaden, recognized as the richest quicksilver mines in the world, have an annual output in the region of 50,000 flasks. A few years ago, two new American furnaces of the latest type were installed to improve production methods and it is believed that two additional furnaces may be installed in the new future.

The American Position

Stimulated by the guaranteed-price programme of the General Services Administration, which remains in effect until December 31, 1957, mine production in the U.S. rose by a further two per cent to 18,830 flasks—the highest rate since 1947. In spite of more than doubling in the last quarter, imports for the whole year declined to 20,647 flasks compared with 65,316 in 1954, being the smallest annual total since 1947. The share of U.S. imports held by Spain and Italy fell from 79 per cent in 1954 to nine per cent in 1955, while Mexico and Yugoslavia increased their shares to 67 and 23 per cent respectively.

Mexican production has also benefited from the U.S. guaranteed price programme, the 1955 output at 1,030 tonnes being approximately double that of 1954. According to the Eti Bank, Turkey produced an estimated 8,000 tonnes of quicksilver during 1955.

Production has been started by Palawan Quicksilver mines, the first quicksilver mining concern in the Philippines.

In assessing the long-term outlook for quicksilver, it should be borne in mind that increasing production will be paralleled by continued progress in instrumentation, which should lead to greatly increased usage of this metal. Furthermore, if the price of quicksilver continues falling, the higher cost producers must eventually be forced out of business.

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Cadmium

THE world production of cadmium has risen from an average of 5,695 s.tons annually in 1945-49 to 7,770 tons in 1954. No estimate of the world total for 1955 can as yet be given, but available statistics indicate that both production and consumption have reached new peaks.

The rapid expansion of cadmium usage is due primarily to the outstanding resistance of this metal to all forms of corrosion. Electroplating is by far the largest use, cadmium being the only plating material which confers complete protection against both the acid air conditions of cities and the salt sprays of marine atmospheres. Cadmium is also a constituent of silver brazing alloys and of the low-temperature-melting bismuth alloys, which are used chiefly as fillers in bending tubing and open sections and play an important part in aircraft construction. Another use is as a constituent of alkaline batteries for mining and other applications, where safety is a prime consideration. In the field of pigments cadmium sulpho-selenide is in growing demand because of the brilliant red colour which it imparts to upholstery and other materials.

World Production

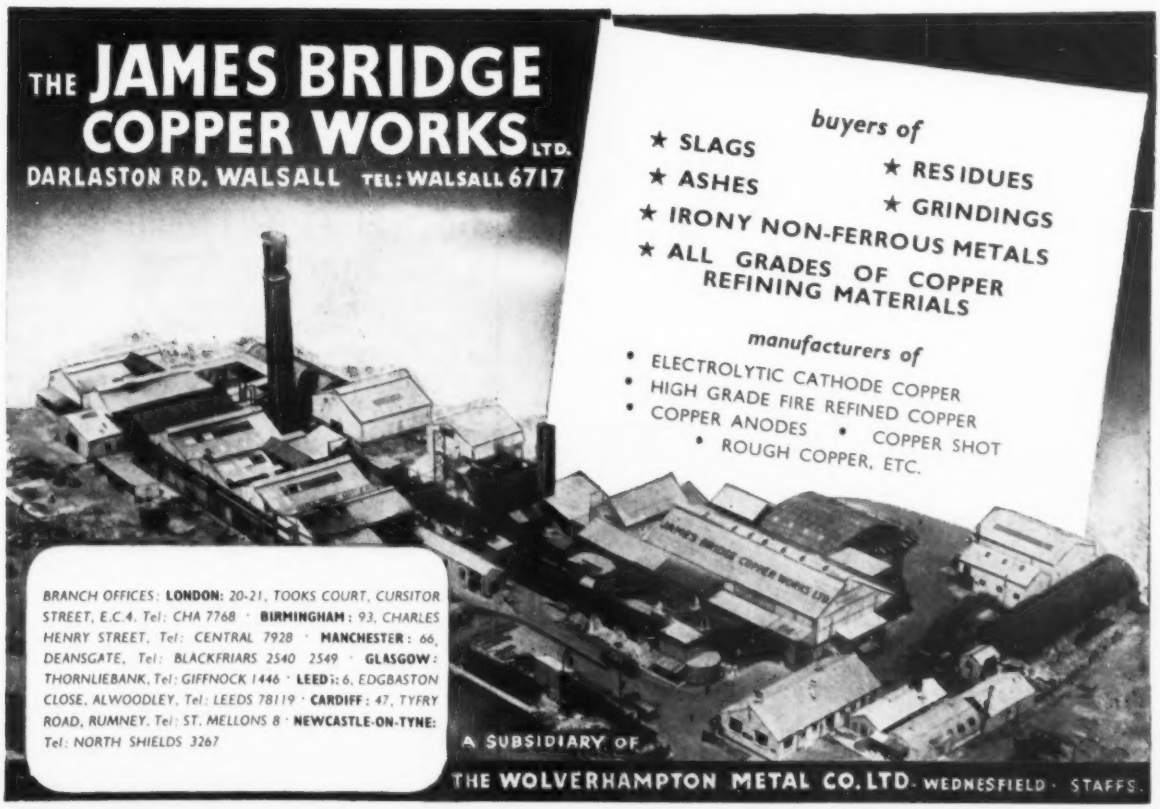
There are no cadmium ores, the entire supply being derived as a flue dust by-product from zinc or lead ores. The U.S. produces nearly two-thirds of the world total and is also an importer of both flue dusts and metallic cadmium. South-West Africa ranks second in the list of world producers, followed in the order given by Mexico, Belgium and Canada.

In 1955, U.S. production of primary cadmium increased by two per cent over the previous year, reaching a total of 4,825 s.tons. About half the production was derived from imported ores and dusts. Apparent consumption of primary cadmium at 5,580 s.tons was 48 per cent higher than in 1948. Exports were at an annual rate in the region of 6,250 tons, exceeding the previous record by 25 per cent.

The U.K. produced 150.69 tons of cadmium in 1955, while consumption amounted to 966.60 tons.

At Kolwezi, Upper Katanga, Belgian Congo, a plant for the recovery and treatment of cadmium, lead and germanium contained in the dust from water jacket furnaces of Union Minière came into operation in January, 1955. The material is shipped to the Olen Works of Société Géneral Métallurgique de Hoboken, of Antwerp. In 1955 exports from the Congo amounted to 140.295 tonnes, compared with about 32 tonnes in 1954. South-West Africa exported 701 s.tons of cadmium in 1955.

The outlook for cadmium in 1956 appears to be highly encouraging. The expansion of aircraft construction alone is regarded as an indication that consumption will continue its upward trend, since virtually all exposed metal parts in aircraft are cadmium-plated, down to the smallest nuts and bolts. In the U.K. there might be a temporary decline in demand from radio and television manufacturers, due to the credit squeeze, but this should be offset by increased consumption by other users. Supplies are ample, while price remains very stable and at the current level of 12s. is sufficiently competitive to stimulate the further expansion of industrial usage.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Asbestos

THE asbestos industry throughout the world prospered in 1955. Apart from the usual seasonal variations, the demand for asbestos raw material remained high throughout the year. It is believed that the general average in most consumer countries was greater than in the previous year, while output was substantially increased. The total Free World production of fibre must now be in the region of 1,750,000 tons annually, while growing competition from the Soviet Union is being experienced in European markets.

Canada's Expanding Production

According to a preliminary estimate by the Dominion Bureau of Statistics, Canada alone produced 1,055,266 tons of crudes and fibres in 1955, valued at $98,690,514, compared with 924,116 tons valued at $86,409,212 in 1954. The entire Canadian production was of the chrysotile variety. Shipments from the Dominion also exceeded a million tons and approached $100,000,000 in value. These record figures were the outcome of expansion programmes aggregating $100,000,000, the full effects of which will not be felt till 1958.

The new Normandie mill of the Asbestos Corporation in the Thetford area started production early in 1955. It is treating 5,000 tons of ore per day from a new mine with developed reserves amounting to 35,000,000 tons. Quebec Asbestos Corporation expects to start production late in 1956 on a new orebody, which is four miles from the company's present ore source. The new plant will have a minimum capacity of 2,000 tons per day. Lake Asbestos, the fully-owned subsidiary of American Smelting and Refining plans to erect a mill of 4,000 tons per day capacity on its Black Lake Property and hopes to start production in 1958. The Munro mine of Johns-Manville in Northern Ontario (mill capacity of 2,000 tons daily) is changing to underground operation.

The National Gypsum Company is to start development work on a new asbestos mine and plant costing over $5,000,000, which will be located 75 miles south-west of Quebec city. Work on the mine itself will begin late in 1956 or early in 1957. The project is scheduled for completion in 1958. Asbestos fibre will be supplied to National Gypsum's three asbestos-cement plants in the U.S.

Canada now has approximately 55,000 tons of daily milling capacity with an additional 10,000 tons envisaged for the immediate future. The Dominion's potential supply of spinning fibres is stated to be considerably in excess of any probable international demand, even in emergency.

Southern Africa

A notable development in 1955 was the start of production in the Temeraire mill of Rhodesian Asbestos Ltd., which serves two highly mechanized mines, one at Shamala and the other at Mashaba, four miles distant, in the Victoria district of Southern Rhodesia. Though smaller as yet than the Shabani undertaking of Turner and Newall, this new venture is making a significant contribution to the Colony's output, which is now in the region of 9,000 tons of fibre per month. In 1955, Southern Rhodesia produced 105,261 tons of asbestos, value at the mine being £7,051,831.

World interest in South African fibres is increasing, a notable feature of last year's operations being the growing importance of Cape Blue. Demand for this type of product is reported to be twice the current production rate and has spilled over into the market for Transvaal Blue. Further expansion of Cape Blue and amosite is proposed.

PRINCIPAL PRODUCERS OF ASBESTOS FIBRE

s.tons

	1954	1955
Canada	924,116	**1,055,216**
S. Rhodesia	80,000	**105,261**
Union of South Africa	109,038	**119,697**
U.S.A.	47,600	**58,000**
U.S.S.R.	240,000	—

Other Producers

The U.S. production in 1955 was approximately 60,000 tons. Vermont was the principal asbestos producing State Arizona sales were chiefly of the non-spinning grades, but also included some high-quality spinning fibre. Small sales of amphibole asbestos were reported.

In Venezuela the Montanita property, which had been partially explored by Turner and Newall in 1954, was purchased outright simultaneously with the acquisition of the El Tigre mine, mill and power plant situated about six miles away. Exploration and development are well advanced and an ore reserve objective of 50,000,000 tons is envisaged.

Swaziland and Cyprus appear to have stabilized production at about 30,000 s.tons and 15,000 tons respectively. Asbestos is also produced in Italy, Yugoslavia, Australia, Finland, France, Japan and Morocco.

The rising cost of imports is stimulating asbestos production in Brazil. Output has doubled since 1952 and now averages 2,600 tonnes annually. Imports have dropped from 11,000 to 8,000 tons and imports of manufactured asbestos, which amounted to 1,300 tons yearly, have now disappeared from trade returns. The Ceara deposits are now being mined, as well as those at Caete, Minas Gerais, and Pocoes in Bahia; a recently-discovered occurrence at Sao Domingo da Prata, in the Rio Doce Valley, Minas Gerais, has started production and another is being examined by the Department of Mineral Production (DNPM) near Dois Irmaos, Goias.

The Outlook

In view of the increases in Canadian mill capacity, there are indications that the supply of all grades has finally caught up with demand, while in some grades output exceeds manufacturing requirements for 1956. Nevertheless the high level of demand in the building and automotive industries is regarded as promising stable markets for the foreseeable future. It is generally believed that the demand for 1956 will exceed that of 1955 by from five to 10 per cent.

Despite the highly competitive conditions now existing, Canadian producers increased their prices at the end of 1955 by about five per cent for the longer grades and 10 per cent for the shorter grades. These were the first price increases since 1952.

In attempting to forecast future demand the President's Materials Policy Commission (Paley Report) concluded that asbestos consumption of all grades in 1975 would be roughly half as much again as for the period 1946-49, implying a demand for spinning grades of approximately 50,000 s.tons and for short fibre grades of 1,000,000 tons. For the rest of the Free World the corresponding figures were expected to be 35,000 s.tons and 350,000 tons. These figures have already been substantially exceeded and no limit to the potential expansion of asbestos consumption is as yet in sight. A point which doubtless has not escaped attention is that Canada's $100,000,000 programme is based on a marketing service and reputation for consistent quality which are unexcelled.

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The Diamond Industry

By a Special Correspondent

IN 1955 an all-time record of diamond sales was reached by the Central Selling Organization of the De Beers group which includes the Diamond Trading Company and Industrial Distributors (Sales) Ltd. The precise figure reported is £74,288,695 which exceeds by nearly £5,000,000 the previous record of £69,661,926 set up in 1952. The 1955 figure is also more than £12,000,000 in excess of the 1954 total. The overall total for the past year comprises £50,253,946 of gem diamonds and £24,034,749 of industrials, both of which figures are records in themselves.[1][2]

In the accompanying table are shown the sales figures for the past twelve years.

Authoritative circles in Kimberley incline to the view that the main significance of the 1955 figures is that they are largely related to current production of diamonds, unlike the 1952 record which was achieved to some extent on accumulated stocks. With demand in the U.S.A. both for gem-stones and industrial diamonds continuing as it is at a very high level, the market is confident that any increase in production in the coming years can quite readily be absorbed. It is also very significant that the value of industrial diamonds sales was higher in 1955 than ever before. This trend is a complete reversal of that since 1952 when each succeeding year had seen a progressive drop in the value of industrial stones sold.

SALES OF GEM AND INDUSTRIAL DIAMONDS

Year	Gems (£000,000)	Industrials (£000,000)	Total (£000,000)	Industrials (% of total)
1944	13.2	3.8	17.0	22.3
1945	21.0	3.5	24.5	16.7
1946	26.1	3.5	29.6	11.8
1947	20.1	4.4	24.5	18.0
1948	26.8	11.3	38.1	29.6
1949	20.0	8.4	28.4	29.6
1950	38.3	12.6	50.9	24.8
1951	46.8	18.3	65.1	28.0
1952	45.8	23.9	69.7	34.3
1953	43.3	17.8	61.2	29.0
1954	45.6	16.5	62.2	26.7
1955	50.2	24.0	74.2	30.9

Reviewing the diamond industry in 1955, Sir Ernest Oppenheimer stated that producers were unable to meet the demand for gem diamonds, although large sums had been spent in recent years on re-opening or re-equipping various mines. Stocks are at a minimum and sales are therefore related to production. There are signs of slackening of American demand for industrials and this will be more noticeable when U.S. strategic stockpile buying ceases.[3] In the first quarter of 1956, the stockpile authorities were, however, reported to be making enquiries for deliveries in 1957 and 1958. At the time of writing, it is not known how seriously these enquiries are being taken in the trade.

Production—Country by Country

Angola. The 1955 schedule of operations of the Angola Diamond Company originally envisaged the treatment of over 1,300,000 cu. m. of gravel for an estimated recovery of 702,000 ct., which may be compared with the 721,606 ct. in 1954. During the year, however, an additional washing plant was in course of installation so that it is anticipated that the original estimate will be exceeded.

In the first five months of 1955, output of the company was 283,618 ct. from treating 591,958 cu. m. of gravel, compared with 291,683 ct. from 570,500 cu. m. in the corresponding period of the previous year. A detailed description of the operations of the company was published during the year. The properties consist of 38 gravel deposits scattered over an area 30 miles in dia. in the Kasai River basin; the primary source is unknown. Diamang's production is about half gems and consists of stones 30 to 10 to the carat. After removal of overburden the pay dirt is recovered either by mechanical excavators or by hand, after which it is removed to one of the 38 concentrating plants. Here recovery is affected by sizing, primary concentration in pans, secondary concentration in jigs, and grease tabling. Iron oxide coats some of the diamonds which, because they will then not adhere to the grease, have to be recovered by hand. Heavy media separation plant, like that used by Consolidated in S.W. Africa, is being installed to treat gravels of which the diamond content is too low to make the ordinary methods payable.[4]

Basutoland. A syndicate called the Basutoland Diamond Corporation under the chairmanship of Colonel Jack Scott has been formed to prospect for diamonds in Basutoland, where the government are said to have described the prospects as good. The area of interest is the so-called Valley of Diamonds at Malibematso which lies at the foot of 10,000 ft.-high mountains. The administration of Basutoland is engaged in constructing a road from Leribe to the valley, and by February, 1956, 35 miles had been completed and there were another 11 miles required to finish it.[1]

Belgian Congo. One of the most comprehensive surveys ever made of industrial diamond mining by Bécéka in the Congo was published during the year by the U.S. Bureau of Mines.[5] The increased use of mechanization in stripping and mining has already resulted in augmented production, whilst new light on the origin and mode of occurrence of the diamonds has led to an increase in reserves to 25 years at the current rule of output. Mechanization has been greatly facilitated by the completion of the Young hydroelectric plant. Output in 1955 is not yet available statistically, but was expected to be again at the 12,000,000 - 13,000,000 ct. level, which is regarded as being the right order of magnitude in the light of the equipment available, the reserves and the world demand. With this production, the Belgian Congo is responsible for about 60 per cent of the world's output of industrial diamonds. Since the commencement of diamond mining the Belgian Congo has produced nearly 200,000,000 ct. or nearly 40 tons of diamonds. The American survey, in addition to covering the economics of the Bakwanga field, also deals with geology, operating practice, production, and financial operations.[6]

Exports from the Lubilash fields (mostly crushing bort) were 12,378,576 ct. compared with 11,573,837 in 1954. Exports from the Kasai deposits were 637,696 ct. against 628,089 ct. in the previous year.

A feature of the open-cast operations of the Disele and Kanshi alluvial mines at Bakwanga is the use of slewable bucket chain and bucket wheel excavators supplied by Orenstein-Koppel and Lubecker Maschinenbau for removal of overburden. This plant, which is similar to that used by Consolidated Diamond Mines of South West Africa, delivers the material to belt-ways for removal to a dump 131 ft.

high and for distribution to the back-filling plant. The argillaceous sand overburden is up to 65 ft. thick with a width of about 4,000 ft. The buckets are of 250 litre capacity operating at 41 dumps per minute, the hourly output being about 803 cu. yd. of loose material. The machine moves by three crawlers each with heads 7 ft. 7in. wide, and it can cut slopes of 45 deg. up to a vertical digging depth of 49 ft. The total weight is 650 tons and which gives a ground pressure of 14 lb. p.s.i.[7]

British Guiana. The discovery of diamonds in a new area in British Guiana has been announced by the Geological Survey, which discovered diamonds in a previously unworked section of the Pakaraima Plateau. A notable development during the year was the wider introduction of diving for the recovery of diamonds in deep pools (up to 50 ft. deep) near rapids in diamondiferous rivers unsuitable for ordinary dredging. The operators use diving helmets and descend by means of weights so as to fill their bags with gravel which is later washed at the surface by conventional methods.

Recent statistics from British Guiana tend to show that there has been a decline in diamond operations in the Colony but the increase in prospecting and the introduction of diving appears to be halting this state of affairs.

A company called Central Guiana Exploration Company was formed during the year to prospect alluvial diamond concessions on the Echilebar, Mazaruni and Merume rivers.[8] [9] [10]

Brazil. Diamond production figures for 1955 remain as big a mystery as those of previous years. There are no official returns of diamond output, and for years expert guesses have put production at about 250,000 ct. annually. It is believed that there was an increase in 1955, however, to something of the order of 350,000 ct.

Since Brazil is one of the few major sources of diamonds in the Western Hemisphere, the United States has a special interest from a strategic point of view in fostering maximum production. The U.S. Bureau of Mines have been carrying out a good deal of work, therefore, with the object not only of reducing costs but also of increasing efficiency in the Brazilian diamond mining industry.

Canada. Although there are no known deposits of diamonds in Canada, the possibility of the right types of rocks being present has long been envisaged, especially as diamonds are occasionally found in glacial drift in southern Canada and the U.S.A. that must have been transported from the north by natural agencies. Special interest, therefore, is attached to the discovery of kimberlite bodies near Bachelor Lake in Lesueur Township, Abitibi-East County in Quebec.[11]

China. The American Consul in Zurich, quoting an item published in the Communist Daily News Release at Peking on May 31, 1955, says that diamond-bearing deposits have been discovered in northern Hunan Province in Central China. Prospecting in the area is said to be in hand.[12]

French Equatorial Africa. In 1955 production amounted to 136,900 ct., compared with 152,900 ct. in 1954. Considered by districts, output from Middle Congo and Gaboon has again shown a slight recession but prospecting is still being actively pursued. Output from Ubangi, however, is continuing to increase and will thus offset declines elsewhere. The situation in Ubangi is one of increased operations in the Eastern district against a decline in Western Ubangi, where the deposits are becoming exhausted. Operations commenced in Western Ubangi only in 1954 and the deposits found are being intensively developed. Most of the mechanization in the industry is to be found in the Western district where there are two small hydro-electric plants, one wood-burning gasogene plant and others where the motive power is supplied by diesel installations.

Gold Coast. According to official reports of the Gold Coast Mines Department for the financial year 1954-1955, the value of diamond exports at £4,432,099 increased by £418,568 compared with the previous year. By quantity the exports were 2,234,572 ct., thus constituting an increase of 64,092 ct. over the previous year's figures. The quantity of diamonds produced in the first eleven months of the calendar year was 2,050,725 ct.

These figures all relate to output by the five companies. Exports of diamonds produced by Africans amounted to 1,128,415 ct. valued at £2,367,224 against 1,200,435 ct. valued at £2,215,915 in the previous year. During the year, 617 digging licences were issued.

The main diamond fields in the Gold Coast are in the Birim and Bonsa districts in the Colony, not far inland from the sea. Industrial Diamonds of South Africa, however, have acquired diamond rights over 80 sq. miles in the Ashanti district in the northern part of the Gold Coast.

A notable feature of the industry during the year was the setting up of a new system of disposing of the diamonds won by native operators. The output of Consolidated Africa Selection Trust Ltd. has always been marketed directly through the Central Selling Organization but that of native workers was until last year effected through the banks. July, 1954, saw the setting up of the monopolistic Accra diamond market for the marketing of native output and after August 1, 1955, it was decreed by the Ministry of Trade and Labour that all African won diamonds must be sold through this market. How this arrangement, which is experimental for twelve months, is working is not completely known but it is said that the Accra market has been paying higher prices than normal, especially for industrials. One attraction over the old bank system, which involved delay of 4 - 5 months before the producer was paid, is the greater speed of settlement. Widely divergent views on the subject of this market and on the comparative prices realized for the diamonds by the actual diggers have been expressed.

Operations by C.A.S.T. Ltd. were interrupted by a strike of African labour in November.[13] [14]

India. Three top-ranking Russian mining and engineering experts have been delegated to India to assist in the mechanization and expansion of the diamond industry. The equipment necessary, which will cost over Rs.60 lakhs, will also be supplied by Russia and is expected to be in operation in 1956, by which time Indian personnel will have been trained and output increased to 10,000 tons a day. Russian geologists have already been surveying the principal field at Panna in Vindhya Pradesh and are understood to have assessed the size of the deposits at two or three times the figure of 11,000,000 ct. of diamonds worth Rs.165 crores, arrived at by the Geological Survey of India. The existence of a regular kimberlite diamond pipe is already regarded as proved. Russian experts are also to survey and prospect the Golconda area in Hyderabad and Andhra States for diamonds.[15]

The Panna Diamond Mining Syndicate has been formed with Government consent with a capital of Rs.10,000,000 (£150,000). This is a new company, but it retains the same title as the previous private operating concern that has worked primitively and sporadically on and off since 1936. There appear to be two types of deposit at Panna; the first and most important are those at Majgawan where there are pipes that constitute a primary deposit, the other being the diamondiferous conglomerate zone of the Shahidan area.[16]

Indonesia. No reliable statistics of production of diamonds from Indonesia are available but output in South Borneo was estimated in 1955 to be at the rate of about 4,800 ct. per month.

At Ngabang, Pontianak in West Borneo, the inhabitants are diving for diamonds in the Sungai Landak river which, during the dry season of June to October, is only about 10 to 15 m. deep. Diving is usually organized by groups of four to 20 people. The proceeds are very variable and output is traded in by local Chinese. Two new diamond deposits of considerable magnitude are stated to have been found on Bahan mountain in Central Kalimantan. The main diamond fields of Martapura have received increasing attention from the government, which is said to be considering modernization of the methods of mining and recovery now used.

Rhodesia. The Federation continues to be almost negligible as a producer of diamonds. Output was only 2 ct. valued at £30 in the latest year for which statistics are available (1954).

Exploration is being carried on by De Beers Consolidated Mines Ltd. in the Kanona area of Northern Rhodesia. An agreement has been reached between the government and the company by which the latter will provide for the extension both of prospecting and producing operations if payable deposits are found. The earlier concession to the company, which bestowed perpetual and exclusive rights, will now be terminated in 1986.

Sierra Leone. 1955 was one of the most momentous years for the country in the history of its diamond mining industry. Until quite recently diamonds were won in Sierra Leone by the Sierra Leone Selection Trust Ltd. in a comparatively restricted area of the country, although the company had rights over practically the entire territory. Some years ago, however, native diggers began to win diamonds illegally in many other parts of the country and the industry grew until it became a major economic and political issue. Conservative estimates put the number of illicit prospectors at over 20,000 and the proceeds from the lucrative industry brought in their train the usual tale of smuggling, get-rich-quick conditions, and crime of all kinds. Smuggling was and is especially difficult to prevent because of the country's 200 mile long mutual boundary with Liberia.

Eventually, after long-drawn-out discussions, it was agreed that the company's rights should be revised so that they retained control over an area of 450 sq. miles which includes their existing properties. In addition, the company continues to have reasonable opportunities for not less than 10 years of prospecting for deep deposits of diamonds and to mine them if found anywhere in Sierra Leone. Some very large figures were discussed by way of compensation for this change in the company's rights, but eventually it was agreed that a sum of £1,570,000 should be paid by the government to the company.

Subsequently it was announced by De Beers that a new company would be formed in Freetown under the chairmanship of Mr. Philip Oppenheimer to buy diamonds from licensed African diggers and to sell them through the Central Selling Organization, which already handles the diamonds of the Selection Trust. It was also announced that Messrs. Triefus and Co. had been appointed official valuers to the Sierra Leone Government.[17] The output of Sierra Leone Selection Trust in 1955 amounted to 418,076 ct.

South Africa and South West Africa. Output of the two territories last year accounted for about 17 per cent of total world production by quantity, but because of the high quality of the stones won, the territories are the leading producers when considered on the basis of value. The most important field continued to be that worked by Consolidated Diamond Mines of South West Africa near the mouth of the Orange River, where, in a gigantic earth-moving operation, about 20,000,000 tons of sand are handled for the recovery of about 7,000 oz. of diamonds, a tenor of about 1/100,000,000. New equipment installed by Consolidated has enabled output in 1955 to be increased from 57,000 to 65,000 ct. a month, while output in 1956 should rise to a monthly rate of 75,000 ct.[18] [19] [20] [21] Output in 1955 at about 850,000 ct. is believed to have been about 25 per cent larger than in the previous year.

Just at the close of the year a new diamond field was discovered on the Skeleton Coast of South West Africa in the Kaokoveld, south of the Kuneme river which constitutes the border with Angola. Stones of good quality have been found and prospecting in early 1956 will be carried out with the object of finding the source.

At the De Beers mine at Kimberley the block caving method of mining is being introduced for the first time in diamond mining, although of course, it is widely used in other types of mining. The main advantages of this method of mining are the great saving in labour and the large reduction in the accident and sickness rate.

Surinam. The Geological Survey of Dutch Guiana has made a preliminary investigation into the occurrence of diamonds in Surinam. Two areas were selected for detailed study and it is concluded that the diamonds probably occur in a metamorphic sub-graywacke—conglomerate.[22]

Tanganyika. Concealed television cameras are being installed at vital places in those sections of the plant where diamonds are actually handled at Dr. J. T. Williamson's diamond mine at Mwadui. A number of De Beers police dogs have also been flown up from South Africa to help in the campaign against theft.

1955 exports of diamonds constituted another record on the basis of value at £3,188,682 (£3,107,241 in 1954) although the quantity exported was slightly less at 322,661 ct. Additions to the Mwadui mine plant to treat 7,000 to 7,500 tons of gravel a day were still being made at the end of the year and it is expected that the augmented equipment will be in full-scale operation early in 1956.[23]

U.S.S.R. Unconfirmed reports crossing the Iron Curtain are to the effect that diamond deposits have been discovered in Russia in the swampy mosquito-infested republic of Yakutia in Siberia. This, if confirmed, is most important for the U.S.S.R. which has always been deficient in the all-important commodity of industrial diamonds. During the war the United Kingdom supplied the U.S.S.R. with £1,424,000 worth of diamonds and this has been calculated to be equivalent to nearly 3,000,000 ct. This is, however, only one-twentieth of the peak consumption of industrial diamonds in the U.S.A. during the war. The extent to which Russian imports were actually used or were stockpiled as far as necessity permitted, is unknown. Authoritative quarters believe that industrial diamonds are still a primary import requirement of the U.S.S.R. from Great Britain.[24] [25]

United States Imports. Figures for imports of rough and cut diamonds into the United States are available only for the first nine months of the year and are as follows :

	carats	*value*
Gem Diamonds		
Rough	829,110	$57,738,032
Cut	522,645	$54,426,178
Total	1,351,755	$112,164,210
Industrial Diamonds	10,784,042	$47,428,858

The U.S. Federal Trade Commission has been asked to include a clause in the trade practice rules that gem diamonds not of natural origin must be described as "synthetic".

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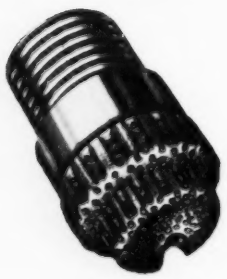

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Venezuela. New diamondiferous areas are reported to have been found in the State of Bolivar in the Upper Caroni and Paragua River region of Venezuela. Rich deposits occur particularly near Peraitepuy, El Poleco, Salva and La Patria. A new diamond mining company has been formed on the basis of Venezuelan and German capital. About 3,000 diggers have trekked to Sureken, south of Bolivar, because Taruepian Indians found good stones near Apoipo.

Fundamental Research and Technical Investigations

Further work was carried out during the year by the U.S. Office of Naval Research on the directional grinding hardness in diamond.[26]

In South Africa investigations have shown that marine acid oils obtained as by-products in refining fish oil can be used after saponification with caustic soda to form a soap solution which is a cheap but effective wetting and flotation medium in diamond-washing operations. Plants at the Orange River deposits have already employed substantial quantities of these acid oils.[27]

Research on the various types of diamond have continued and a statement that large gem diamonds are always type I diamonds was refuted by the Diamond Research Laboratory.[28] The latter organization also published work on type IIb diamonds as semi-conductors.[29] [30] Work on the diamond as a radiation counter was continued and was recognized by the award of the City and Guilds Insignia Award in Technology to Mr. V. F. Cotty who is Technical Adviser to the London committee of the Diamond Producer's Association.

Industrial Diamond Applications

The 11th in the series of comprehensive reviews of the diamond tool industry summarizes developments in all aspects of the diamond, including scientific investigations (types of diamond, effect of irradiation, counting properties, X-ray analysis, abrasiveness and morphology), hardness, surface finish testing, precision boring and turning, truing, diamond powders, impregnated tools, stone sawing, glass grinding, mineralogical and metallographical polishing, rock drilling, wire-drawing, reclamation, machining methods, jewel production and diamond polishing and setting.[31]

Diamond core and blasthole drilling continue to constitute one of the large outlets for industrial diamonds throughout the world. In Canada alone it is estimated that more than 10,000,000 ft. of diamond drilling are carried out annually. During the year no new use of diamonds was developed that will constitute an additional major outlet for industrials but there was an increase in the use of diamonds in stone saws and in diamond drilling.[32][33][34][35]

Conservation, Recovery and Substitutes

Because most of the major industrial nations are almost completely deficient in domestic sources of strategically vital industrial diamonds, a great deal of attention is being given to the problems and techniques of conservation, recovery from wastes and partly-used material, and the utilization of substitutes.[36] Electrical methods of cutting diamond and other hard materials have been developed in order to reduce the wastage in cutting.

Improved methods of recovering diamonds from ore concentrates have been the subject of intensive research. In this connection a new type of electrostatic separator has been developed by the U.S. Industrial Test Laboratory at the Philadelphia Naval Shipyard.

Reclamation of diamonds from swarf has been practised at the Chrysler Corporation works in recent years to such an extent that 15,000 ct. of diamonds have been recovered. This company alone uses over 7,000 diamond tools and grinding wheels, for boring, lapping, reaming and grinding.

The use of substitutes continues to be actively investigated especially in the U.S.S.R. and U.S.A. Silicon carbide substitutes are being used where the reduced speed, accuracy and efficiency as compared with diamond can be tolerated or offset by a reduction in costs.

Synthetic Diamonds

By the time the 1955 Annual Review appeared, the successful production of synthetic diamonds had only just been announced (February 15, 1955), but during the year further details became available. In one series of tests by G.E.C., a carbonaceous compound was subjected for many hours to very high pressures, and a crystal, identified as diamond, was produced which was $\frac{1}{16}$ in. long in its maximum dimension. Other work led to the design and development of the "belt"—a chamber enabling temperatures of over 5,000 deg. F. to be maintained for the first time at pressures of over 1,500,000 lb. p.s.i. This, it has been calculated, is equivalent to the pressure in the earth at a depth of 240 miles. With this equipment diamonds, though smaller than in the first tests, were made in minutes, sometimes in crystal clusters. One hundred and two repeats of the synthesis and many exhaustive identification tests were carried out. Some of the synthetic diamonds are so hard that they will scratch natural diamonds.[37]

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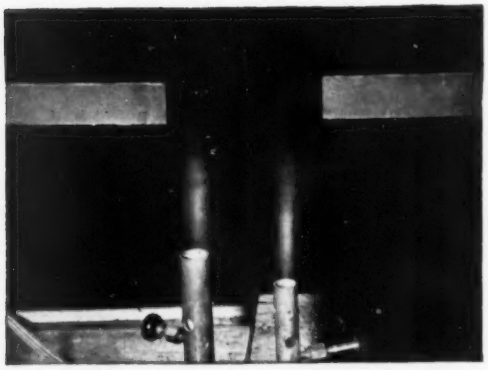
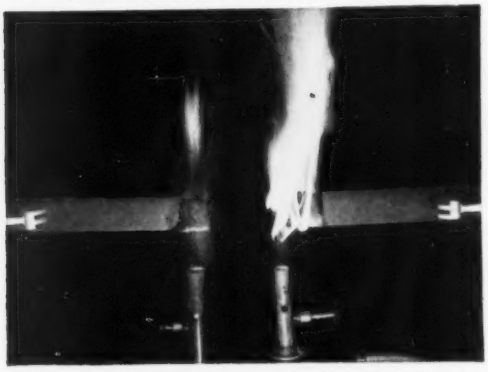
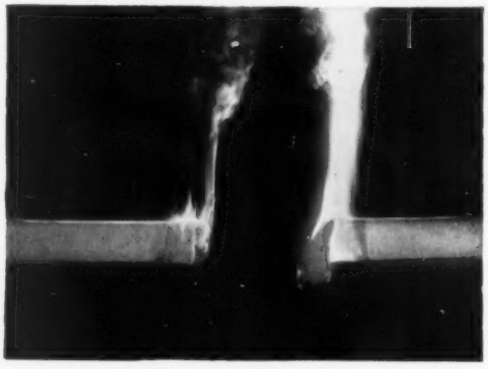


Stage 1 Before the start of the test. Geon PVC belting on the left, rubber belting on the right.



Stage 2 Both bunsens moved into position simultaneously. Rubber belting in flames. Geon PVC belting only charred.



Stage 3 Bunsens removed. Rubber belting continues to burn fiercely; partially destroyed. PVC belting, though smoking, is seen to be hardly affected.

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The Coal Industry

By A. GRIERSON, B.Sc., M.I.M.E.

THE past year has seen a continuance of the coal scarcity which has plagued most of the Western countries since the war. In all major European countries American coal has been necessary—in quantity—to fill the gap between internal supply and demand. Production in the principal coal producing countries is shown in the table, from which the outstanding feature is seen to be the resurgence of the American coal industry.

MAIN PRODUCING COUNTRIES
(in millions of metric tons)

	1953	1954	1955
U.S.A.	442	380	**446**
U.S.S.R.	320	350	**390**
European Communities	321	332	**340**
Great Britain	228	228	**226**
Poland	89	91	**94**
India	36	37	**38**
Union of South Africa	29	29	**36**
Australia	23	28	**30**
Canada	16	15	**14.5**
Yugoslavia	11	13.5	**15**
Austria	6	6.5	**7**

These figures include lignite.

The United States

The situation in the U.S.A. is in startling contrast to that of a year ago when many mines were operating a three day week. However, this year has seen a tremendous upsurge of demand — both home and foreign—and the industry as a whole has regained stability. The anthracite industry did not share in the boom and production dropped by eight per cent on the previous year's figures—27,120,000 tons to 24,900,000 tons. Difficult working conditions and the highly competitive prices of gas and oil have almost sounded the death knell for many anthracite operators. However, the threat to bituminous coal markets of oil and natural gas seems to have receded. Demand for oil and gas is considered to be taxing available supply, so that future increases in energy requirements will be met by coal.

So stable is the industry that the operators were able to take in their stride a $2 per shift increase in wages; $1.20 per day from September 1, 1955, and a further 80 c. per day on April 1, 1956. This rise brought the basic daily wage of soft coal miners up to $20.25. The burden of the rise was immediately shifted on to the public in the form of increases in coal selling prices ranging from 25 c. to 40 c. per ton and the very fact that the operators could do this so easily is indicative of the healthy condition of the industry.

It is expected that demand for American coal will continue, and many operators are predicting full order books for the next five years. There seems to be every reason for optimism. Internally the steel industry is consuming 25 per cent more coal than of recent years and sales to the electric utilities are up by 20 per cent.

It says much for production methods that the increase in output this year was achieved with a reduced labour force. The total number of men employed in the bituminous and anthracite fields is now approximately 240,000; almost 30,000 less than last year. Productivity in the bituminous mines was just on 10 tons per manshift —a rise of two tons in three years. This is partly due to the increased use of bigger and better power loaders, together with mergers within the industry which have had the effect of establishing combines capable of closing inefficient mines.

The U.S. exported 35,000,000 tons in 1955, Europe providing the biggest market. Taken all round the U.S. coal industry had an excellent year and the immediate prospects are regarded as hopeful.

Western Europe

Although coal and lignite production in the six nation European Coal and Steel Community showed a gain of 8,000,000 tons, demand continued to exceed supply. During the year demand increased by 16,000,000 tons and the difference had to be made up by increasing imports and drawing from stocks which are now less than 8,000,000 tons.

Decreasing manpower is reported as being the prime cause of insufficient production and the year saw a drop of 10,000 men in the number employed on the mines. This falling manpower is expected to prove the limiting factor in the plans to boost production in the next few years. Towards the end of the year the Community were on the verge of declaring an official shortage of coal. This would restrict the existing freedom of member states by obliging them to sell preferentially to Pool countries thus ensuring that urgently needed indigenous coal could not be sold outside the community.

During the year the Pool countries experienced an unprecedented economic expansion and in the field of iron and steel reached the production level previously forecast as the goal for 1957, but as already indicated there was no commensurate gain in productivity from the mines. It is expected that some 36,000,000 tons will have to be imported during the current year if demand is to be met—two-thirds of this shortfall is from the U.S.

The production of coal in the Community is indicated in the following table.

HARD COAL PRODUCTION IN THE COMMUNITY
(Excluding lignite)
(in thousands of tonnes)

Country	1953	1954	1955
Belgium	30,060	29,240	**29,960**
France	52,588	54,406	**55,322**
Saar	16,418	16,817	**17,298**
Germany	124,472	128,018	**130,728**
Italy	1,126	1,071	**1,119**
Netherlands	12,297	12,079	**11,843**

Great Britain

Another disappointing year. Output of deep mined coal at 210,190,000 tons was 3,370,000 tons below that for 1954. This pill was sweetened by a 1,300,000 ton rise in opencast production to 11,370,000 tons leaving an overall deficit of just over 2,000,000 tons. The total labour force in the mines dropped by some 3,000 men to 704,000 and despite increased mechanization—22,000,000 tons power loaded—O.M.S. dropped slightly to 24.5 cwt. Despite falling manpower the National Coal Board commendably continued its policy of full-scale development and more men than ever before (38,500) were employed on capital, development and special work.

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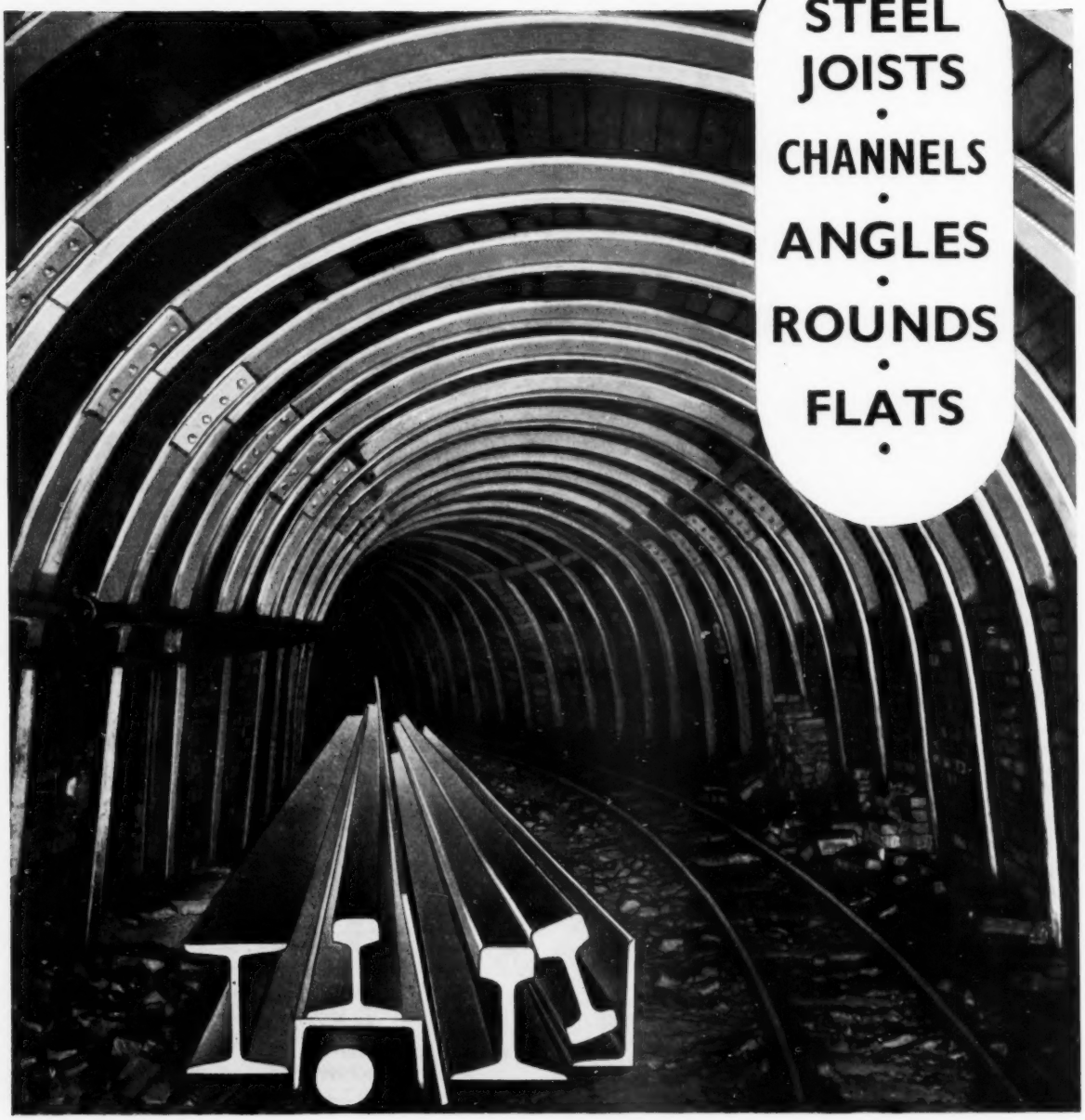

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The industry was plagued with strikes and restrictive practices during the year, industrial unrest accounting for a loss of almost 3,000,000 tons of coal—the highest since nationalization. Coming at a time when every ton of coal is vital to the industrial economy of the U.K., these irresponsible actions have been soundly condemned by the Mineworkers' Union officials. More than half the lost output came as the result of stoppages in Yorkshire.

Stocks at the end of the year were higher than any winter since the war, mainly because of reduced exports and increased imports. Almost 12,000,000 tons of coal were imported during the year and the first steps taken towards the long overdue surrender of the British export market. Increasing inland consumption over the past years has made this move inevitable and it is intended that in the current year only essential "food" markets such as Denmark and Eire will receive British coal.

Whither Coal?

With the exception of North America, demand for coal continues to outstrip supply, and plans to expand the coal industry have been formulated by many countries. In Britain the National Coal Board is pressing forward with a £600,000,000 national development project aimed at raising the annual output to 250,000,000 tons by 1965, and other European countries are pursuing a similar policy. In the U.S. demand is expected to reach 600,000,000 tons per year by 1960 and large-scale expansion plans are afoot. Typical of these is the $20,000,000 new mine to be constructed for Pittsburgh Consolidation Coal Co., this being the third large mine to be opened by this company—the largest commercial producer in the U.S. It is estimated that almost $1,500,000,000 will be spent over the next ten years on providing new capacity and making good wastage during this period.

From the Far East comes news that India is planning to boost production by almost 50 per cent in an endeavour to keep pace with the large-scale technical developments envisaged for that sub-continent. If India and other heavily populated and under-developed countries, such as China, are to carry through an industrial revolution on the scale contemplated, the first move is to utilize to the full the industrial potential lying dormant underfoot. It is apparent that the rate at which fuel can be made available will be a governing factor in internal development, and that the problem facing Asia and indeed the entire world, is to meet a vast demand from reserves of coal, oil and gas that are not inexhaustible.

At the moment these fuels constitute three-quarters of the world's present energy supply, and although current estimates of coal reserves appear reassuring—sufficient for three thousand years at present rate of extraction—it must be realized that only a small fraction is recoverable at a reasonable cost. What is of even greater significance is the uneven distribution of these reserves: two-thirds of the non-communist world's supplies lie in the U.S.A. Supplies of special coals such as those required for the production of metallurgical coke are rapidly becoming depleted and although selective blending is partially plugging this drain, this can be considered as no more than a temporary expedient.

Higher Utilization Efficiency vs. Growing Demand

As living standards rise so then does energy consumption—assuming a constant efficiency of utilization. In Britain, for example, the total consumption of energy per head of population has remained relatively static for the past 50 years at about 4½ tons coal equivalent. The manifest rise in living standards without increase in fuel consumption has been achieved by a corresponding increase in fuel utilization efficiency. However, in Britain, as elsewhere, it is becoming increasingly difficult to improve the energy output/input ratio and further rises in living standards will need more fuel. Where is this additional fuel coming from?

Estimates suggest that by 1985 energy demand in Britain will be 458,000,000 tons coal equivalent. It is hoped that by this time nuclear energy will be doing the work of 94,000,000 tons of coal, and will constitute nearly two-thirds of the fuel consumed at power stations. Provisional estimates assume satisfaction of an oil demand equivalent to 155,000,000 tons coal. Thus if Britain is to continue to develop as planned the Atomic Energy Authority and the oil companies between them are being counted upon to perform the prodigious task of providing in the space of 30 years, new sources of energy greater than the current entire deep-mined output of British collieries. Fortunately the spectacular developments in the field of nuclear energy afford hope of industrial atomic power being available at the right time and in the required quantity, not just in Britain but in all progressive countries.

It is estimated that by the end of the century world energy demands will need some 6,500,000,000 tons of coal as compared with the 1,700,000,000 tons currently used. Estimates suggest that Western Europe's fuel requirements may be tripled in the next twenty years. There is little hope of the coal industry satisfying this demand.

Oil from Coal

Until nuclear energy is economically competitive with coal and oil, if a choice is possible, there is no reason to assume an abrupt changeover. However, by the end of the century atomic scientists predict that nuclear power may well take over most of the work done by coal at just about the time that rapidly dwindling oil reserves need to be supplemented by the production of liquid fuels from coal. Supplies of oil may run short early in the next century and oil from coal appears to be a possible solution.

There are already two technically sound methods of obtaining liquid fuels from coal—hydrogenation and the so-called Fischer-Tropsch process. In America it seems likely that hydrogenation of coal will be an accomplished large-scale commercial proposition within two years. Plants of 6,000 tons daily capacity are envisaged. Such plants in the nuclear power age would serve the dual-purpose of maintaining a market for coal and producing essential oil.

In South Africa the world's first large-scale synthetic Fischer-Tropsch plant is now in production. This plant came into operation for broadly the same reasons as will justify large-scale oil-from-coal plants in other countries 50 years hence; namely availability of coal but shortage of oil.

A preliminary investigation is being made into the possibilities of producing oil from coal from the Lubimbi coalfield, near Wankie in Southern Rhodesia.

Coal's Future Assured

What then are the prospects for the coal industry? Worldwide expansion is vital if progress is not to be retarded in the period between the present and the atomic power era. Even if nuclear energy does eventually replace coal at power stations, etc., coal will always be an indispensable commodity whether in its natural state or processed, and its future is assured. Paradoxically the problem is not "What of the future," but rather "What of the present?"

Mr. Felix E. Wormser, U.S. Assistant Secretary of the Interior, in a report presented to the Interstate Solid Fuels Conference, predicted that in the decade 1965-75 the market for coal would be far greater than any experienced up to the present time.

Oil

By W. J. HARRIS

AS the accompanying table shows, provisional estimates for 1955 indicate an output of a record 786,000,000 tonnes—an increase of almost 80,000,000 tonnes compared with the previous year. Since production rate is always most closely related to consumption, it follows that world oil requirements in 1955 expanded appreciably. It may be remembered that in surveying the picture a year ago it was said that the oil industry was envisaging the time when an annual output of at least 1,000,000,000 tonnes would be needed to satisfy international demand. The rise in this demand implicit in last year's production level suggests that the annual output just cited will very soon indeed become a necessary target.

Britain's Need for Oil

To give a typical instance of the way in which oil consumption is rising in different countries, consider the case of Britain herself. Latest figures to hand are for the consumption of finished oil products (exclusive of bunker fuel for ships engaged in the foreign trade) in the U.K. for the first nine months of 1955. Total deliveries of petroleum products during the period in question were 17,235,018 l.tons as against 15,526,344 tons for the same period of 1954; in other words there was an increase of approximately 11 per cent.

In the case of some important individual finished products, the increase percentage was considerably higher. Thus the growing demand for fuel oil as a source of industrial energy led to an increase in consumption of 21 per cent. Similarly, the use of gas oil by Regional Gas Boards to enrich supplies of town gas was partially responsible for a 12 per cent rise in deliveries of gas/diesel oil—though this additional consumption also reflected the growing preference for diesel tractors in place of those using vaporizing oil. It is worthy of note that total U.K. oil consumption during January/September last was greater than that for the entire year 1951, when annual consumption was just below the 17,000,000 ton level.

WORLD CRUDE PRODUCTION
Including natural gasoline
(In thousands of tonnes)

	1954	1955
U.S.A.	338,300	**357,000**
Venezuela	99,400	**111,000**
U.S.S.R. (inc. Sakhalin)	58,000	**70,000**
Kuwait	47,700	**54,800**
Saudi Arabia	46,900	**47,600**
Iraq	30,700	**33,700**
Canada	13,000	**17,200**
Persia	3,000	**16,000**
Mexico	11,900	**13,000**
Indonesia	10,700	**11,300**
British Borneo	4,900	**5,000**
Other countries	44,200	**49,500**
World Total	708,700	**786,100**

N.B.—Estimates for 1955 are preliminary and provisional.

Moreover, future proposals regarding British industrial development and energy supplies foreshadow yet greater usage of finished petroleum products. In January of this year (1956), it was authoritatively submitted at a fuel efficiency conference at Slough that one in four of all manufacturers using coal to-day would be obliged to change over to oil within the next three or four years. This assumption was based on the probable annual increase in U.K. industrial energy demand set against the maximum annual coal output that it is logical to expect. On this basis, it was estimated that there would by an energy deficit equivalent to 50,000,000 tons of coal by 1960 and an even bigger deficit, equal to 75,000,000 tons of coal, by 1975. These calculations pay full regard to the contribution to our energy supplies expected from atomic energy during the next twenty years. The only efficient "bridge" by which the potential energy "gap" can be spanned is through the utilization of additional quantities of oil fuels. Clearly, the greatest pressure will fall upon those fuels capable of directly replacing coal and consumption of these products—just under 8,000,000 tons in 1955—is expected to exceed 20,000,000 tons in 1960. This is, of course, in pursuance of the Government's declared policy of actively encouraging increasing use of liquid fuels wherever practical in industry to relieve the strain upon coal supplies.

Also in 1955 came British Railways' publication of the drastic remodernization programme to improve rail transport—a programme which embodies the gradual replacement for steam locomotives by electrical and diesel traction. Indeed, the order for the first 141 complete diesel-electric locomotives, together with a further order for 30 power-units to be used in construction of subsequent locomotives, was placed before the close of 1955.

Vast Capital Expenditure

It goes without saying that catering for this inexorable increase in world oil requirements maintains a relentless pressure upon the oil industry's financial resources as well as upon its production capabilities. Only recently an executive of one of Britain's major oil companies spoke of the industry being faced with a capital project expenditure of the order of £2,000,000,000 annually for the next 25 years. The need for such tremendous spending was shown during the close of 1955 when various British oil companies and companies interested in tanker operating reviewed their new tonnage requirements and found that these necessitated the placing of orders worth some £200,000,000. It may be mentioned in passing that of this total, work worth an estimated £125,000,000 was placed with U.K. yards.

When one considers the oil industry's recurrent need of construction, not only of new tankers but of additional pipelines, refining capacity and production facilities in existing oilfields—to say nothing of the vast sums incurred in course of oil exploration programmes—it is easy to see how expenditure running into several thousands of millions of pounds a year enters the industry's monetary commitments.

What of the physical feat of production itself. As comparatively recently as 1946, output in the Middle East region was 35,500,000 tonnes. That for 1955 is known to have well surpassed 150,000,000 tonnes. To have raised Middle Eastern annual production by considerably more than 100,000,000 tonnes within a decade is a major achievement in whose accomplishment British interests can be proud to have participated so strongly. These interests are, of course, also substantially concerned in the oil production of Venezuela; hence it is gratifying to be able to report that the latter country's 1955 output (assessed at 111,000,000 tonnes) has exceeded 100,000,000 tonnes per annum for the first time in Venezuela's history as the leading Latin American oil-producer. It is further encouraging to see that the output of the world's largest oil-producing country, the U.S.A., which sustained a marginal decrease in 1954, is estimated to have achieved an all-time record for any year.

Parallel with actual production has gone the search for fresh oil resources—a search often overlooked until some sizeable discovery makes temporary headlines, but one which is as permanent a feature of the oil industry's cur-

riculum as the recovery of crude oil itself. Since this search is being conducted in practically every country in the world, it is impossible to review it in any detail. In Canada where, incidentally, British participation in oil exploration has lately strengthened, some 200,000,000 acres of land are undergoing investigation and development and about 150 geophysical survey parties, plus 260 drilling rigs, are busy. In Australia, where the quest for petroleum deposits has been in progress since the early years of the present century, some £25,000,000 has so far been spent without any commercial discovery materializing. Nevertheless, with roughly a million square miles now covered by concessions, the search for oil there is going on more vigorously than at any previous time and it may yet be that Australia will one day take her place among the oil-producing countries of the world. A reminder that such searches can indeed have happy endings, is afforded by the recent discovery of the Parentis oilfield in France, about 50 miles south-west of Bordeaux.

Drilling at Greater Depths

The Parentis field came into operation early in 1954, during which year it supplied about 130,000 tonnes of oil. However, its production rate as at the end of 1955 was expected to prove the equivalent of 1,000,000 tonnes a year —which will, of course, be more clearly reflected in the French oil output for 1956. During 1955, underwater search began for extensions of the Parentis oilfield thought to lie beneath the Lake of Biscarrosse, and already production from beneath the bed of the lake has been initiated.

This global search for petroleum is also extending to the testing of rock formations at progressively greater depths. In the East Texas basin of the U.S.A., a considerable interest is being shown in exploratory drilling taking place in rock formations far older than those from which the bulk of the area's current oil production is obtained. Investigation of the submerged areas of the Continental Shelf is also making steady progress. Shortly before the end of 1955, preparations were made for the drilling of a test borehole some 60 miles off the Texan coast—20 miles further from land than ever before in the Gulf.

Specific interest in the exploration of the sea-bed is, of course, by no means confined to work off the coasts of the U.S.A. It is taking place in the Persian Gulf and also off the coast of British Borneo where production is already established. By increasing the depths to which their drills can penetrate—the 20,000 ft. level has now several times been exceeded—by expanding their offshore theatres of operations and by maintaining their search for fresh oil-producing areas, the oil companies are tirelessly seeking to add to their petroleum reserves.

High Level of World Reserves

To the same end, much intensive research has gone into the artificial repressurization of existing oilfields, by which means such fields have frequently been restored to productivity after having earlier been abandoned as worked out. This specialized scientific production and conservation technique has made it possible for the oil industry to estimate the world's proved reserves as being at a higher level at the beginning of 1955 than at any other time in the industry's history—and proved reserves, it must be remembered, are only the industry's "working stocks," infinitely less than the world's possible reserves, which are calculated by an appraisal of all the actual area of the earth's surface likely to contain oil. The industry is supremely confident of its ability to meet all foreseeable demand for its products for generations to come.

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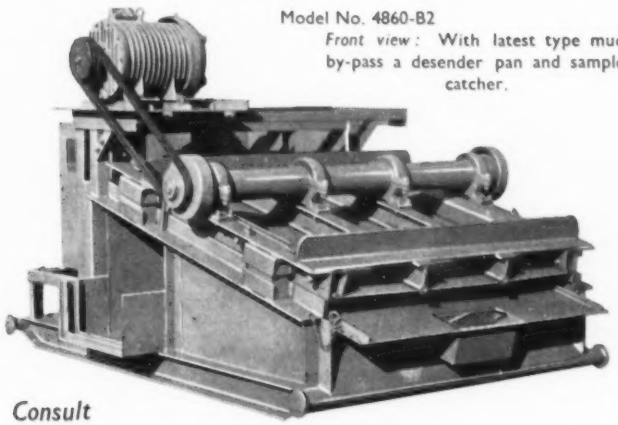

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How Long will our Metals Last?

By GRAHAM OLDHAM, B.Sc., F.R.I.C., D.L.C., M.Inst.F.

IT is, from time to time, highly desirable that one should stand back a little from the more immediate and pressing problems of life and try to form some idea of the nature of the road along which our civilization is travelling. It is the purpose of this article to assess the present position and to forecast, dangerous though this may be, some of the problems which may well affect the mining industry in the future.

Estimates of Some World Mineral Supplies

Many estimates of the life of the known reserves of various metals and minerals have been made from time to time. Sometimes these have been wildly speculative but in any case the most carefully computed estimate must be treated with reserve. In the first place, estimates of world reserves of a particular ore can only be provisional, since they can take no account of undiscovered sources. Secondly, figures of present world rates of consumption give little indication of future consumption rates.

Consider, as an example, the case of world iron supplies. At the present rate of consumption, supplies will last for about 200 years. This figure does not take account of ore deposits, which, from their size, composition, and location, cannot be commercially exploited. If we assume that all such known supplies can ultimately be worked up, then iron supplies will last for over 600 years. If, on the other hand, world consumption were to rise to the U.S. rate, supplies would last for only 25 years, or 75 years assuming all ore supplies could be worked. In addition, we have possible inaccuracies due to uncertainty in, for example, the U.S.S.R. estimates and in the fact that consumption figures have not been adjusted for population trends. The true figure probably lies somewhere in the middle, in the region of 100 years. Some countries are already being brought face to face with the problem. The American iron and steel industry is threatened with the exhaustion of its Lake Superior reserves within the next two decades and must either utilize the ores of South America or turn its earnest attention to the concentration of the taconites.

Manganese will probably last as long as iron and, in any case, its use could, to some extent, be dispensed with in the iron industry. Known chromium and copper supplies may well be exhausted in 30 years, lead, zinc, and tin in rather less. Bauxite supplies will probably last rather over 100 years and tungsten about 80. These figures may well be disbelieved by the reader and the author, it must be admitted, does not put them forward with excessive confidence. Unpalatable though the facts may be, the figures are at least, as far as we can say at the moment, of the right order.

It is only a short time since we were faced with the threat of a severe sulphur shortage. The position has, temporarily, eased and the general public has quickly forgotten about the crisis. In the future there will be more threats of this kind and there will be increasing point to them. The answers to this highly complex problem must be sought now ; they cannot be left to the uncertain future.

Discovery of New Mineral Supplies

New supplies will be discovered ; there is, of course, no doubt about that. The opinion has been expressed in many quarters that new mineral sources resulting from the discovery of extensions to known deposits will keep pace, for several generations at least, with the mining of metallic ore. As these then show signs of exhaustion, man will have to mine deposits in more inaccessible areas and, in addition, as metal prices rise, deeper mining will become economically more possible. In recent years, developments in both electronics and aviation have revolutionized prospecting techniques and the application of new methods is increasing and will increase mineral discoveries. The outlook for a major improvement in mineral reserves with the introduction of more modern techniques is not the same all over the world. The U.S., for example, has been very thoroughly prospected and improvements there can only come about by the exploitation of orebodies which cannot, with the present technical knowledge, be worked economically. On the other hand, there are large areas in Africa, Asia, and South America which will undoubtedly repay more intensive prospecting.

It is an unfortunate fact that world mineral reserves are poorly distributed with respect to existing populations and consumption, and this maldistribution alone presents further complications. Mineral discovery and development are expensive processes and must be financed, but many governments show an appalling lack of interest in such work. Some readers may well believe that developments of the mining industry are not the concern of governments, but geological mapping and research in geology, geophysics and geochemistry ought, at least, to be a matter for government concern.

Conservation in Production

The battle against the depletion of reserves must first be waged in the field of mining and milling. Of increasing importance here is the utilization of low-grade ores. Since 1910 we have seen the introduction of concentration techniques and the amount of beneficiation of low-grade ores has steadily increased. In the field of iron metallurgy there are great possibilities in the utilization of taconites. Aluminium supplies may be improved by the production of the metal from clays, although from an economic point of view such methods cannot compete at the moment with production from bauxite. An example of what can be done in the way of utilization of a low-grade source is the extraction of magnesium from sea water which contains only 0.13 per cent magnesium.

New mining methods and increasing mechanization provide the preliminary essentials for cheap exploitation but there are, at the same time, social problems to be faced, as well as purely technical ones.

An interesting development in the field of iron and steel production is the use of high percentage oxygen instead of air both for smelting and converting. Smelting may be carried out in a low-shaft furnace to yield, not pig-iron in the accepted sense of the word, but an intermediate product yielding steel on being blown with high percentage oxygen in the converter. Operation by this process is said to be economical and to decrease production time by 20 per cent. It should enable low-grade ores, previously considered unusable, to be smelted and hence extend the life of present supplies.

Metal Losses Due to Corrosion

The amount of direct wastage of metal supplies by corrosion is very difficult to estimate but in the United States it is said to be over five billion dollars per year. There are also indirect losses which are not so easily recognized, an

example being the overdesign of equipment in order to take care of corrosion. If it were not for the effects of corrosion, the factor of safety in designing boilers and condensers, pipelines, water tanks, etc., might well be considerably reduced.

One rather startling corrosion loss is the loss due to internal combustion engine corrosion which, surprisingly, accounts for about one-fifth of the total bill. Recent work indicates that this can, to some extent, be controlled by the addition of inhibitors to oil and fuel and by the use of corrosion resistant alloys for cylinder liners, piston rings, valves and valve seats.

Corrosion in pipelines and other buried structures can be controlled by cathodic protection using sacrificial anodes of magnesium, aluminium or zinc. In effect this is merely a transfer of corrosion from pipe to anode and, while there may be an initial saving of steel due to the use of thinner walled pipes, the loss of anode material must be offset against this.

Some methods of combating corrosion losses have been indicated, but there is a great deal of room for improvement in this field. Apart from the direct protection of metal surfaces, it must be remembered that the atmosphere itself causes much decay. Considering natural factors only, atmospheric corrosion should diminish as the distance from the sea increases. As areas of large population are approached, the converse tends to occur. The preponderating factor here is, undoubtedly, the presence of sulphur dioxide in the atmosphere. It is, quite clearly, of extreme importance that sulphur compounds should not be discharged into the atmosphere. The advantages of such control are threefold. There will be an improvement in the health of the population, there will be a reduction in corrosion losses, and there will be an increased conservation in sulphur supplies.

Yet another important factor is that minerals, already in short supply, are being used excessively in corrosion protection. It may be that a more intensive study of low-alloy admixtures and their susceptibility to electrochemical attack should be made in an effort to combat these losses.

Conservation of Supplies by Substitution

A large factor in the conservation of our metal supplies is the question of substitution. Firstly we may have the substitution of a metal likely to be in short supply by one which seems likely to last for a longer period. In this field, the light metals and minerals of marine origin are of great importance. Aluminium and aluminium alloys may frequently be used instead of steel and, in many cases, require no special corrosion treatment. Roof trusses, bridges, cranes, dragline excavators, lifeboats, etc., have all been constructed in aluminium with a saving in weight of anything betwen 20 and 60 per cent. Because economics rather than geology have, in the past, governed exploration, it may be that supplies of bauxite are far in excess of the available figures and such substitutions may therefore be of great value. Aluminium has also found considerable use as a substitute for copper in, for example, electrical transmission.

Magnesium is another light metal which is making progress. The more extensive use of this metal is to some extent hampered by the economics of the metal and alloy position and by prejudice regarding the fire risk. The reserves of this element in sea water amount to something of the order of 2×10^{15} tons and this is a factor which will ultimately prove to be of extreme importance.

Another "new" metal which is only just beginning its career is titanium. This the fourth most plentiful of those metallic elements in the earth's crust which may be used structurally and it is superior in its strength to weight ratio to the three more abundant metals. The increasing use of titanium will play its part in lengthening the life of supplies of some elements at present more important industrially.

In the field of substitute materials plastics have a part to play. Glass fibre reinforced plastics are finding increasing use and are amazingly strong and resilient, tensile strengths rising to over 37,000 p.s.i. It is now common to find lead substituted by the thermoplastic resins which are flexible, weldable and resistant to corrosion. Plastic piping is also finding increasing use in place of copper piping, particularly in situations where continued vibration is likely to cause metal fracture. Pipes may, in fact, be made from a wide range of plastic materials including epoxy glass, polyester glass, cellulose acetate butyrate, polyethylene, styrene rubber and polyvinyl chloride, and plastic pipelines of over ten miles in length have been constructed for the chemical industry.

Polyethylene, for example, is now finding increasing use due to its ease of fabrication, its excellent chemical resistance and its high impact strength. It is used in centrifugal fans, valves, piping, acid tanks and duct lines. Plastic components are also being adopted for mechanical equipment and find use as bearings, gears, rollers, etc., and plastic valves may be obtained operating at temperatures above 400 deg. F. Substitutions such as these, which are likely to increase, all will play their part in helping to conserve supplies. Nevertheless, at the moment, such substitutions are not really significant and maximum utilization of plastics will not be realized until more reliable data is available on such important mechanical properties as creep, fatigue, and rupture together with a much greater standardization in quality.

Conservation by Scrap Recovery

The importance of scrap as a source of supply has often been underestimated and it has been considered in some quarters that the supply of scrap offers a threat to new metal production. This is not, in fact, true since the availability of old scrap is really a reflection of civilization's progress and is inevitably accompanied by an increasing demand for virgin metals. The position with regard to scrap recovery is not entirely satisfactory. Iron and copper are recovered to the extent of 65 per cent, lead 60 per cent, aluminium 40 per cent, zinc 25 per cent, tin and nickel only 20 per cent. Metals such as chromium, manganese, molybdenum and tungsten have very low recovery factors since they are usually present as alloying elements and either find their way into ordinary mild steels or are lost in slags. It is evident that there must be more efficient channels for the return of damaged and obsolete metal articles, together with improved scrap treatment in order that constituent metals may be recovered in a high state of purity.

Synthetic Metals a Possibility ?

The last few decades have seen the production of so many synthetic materials that it might not, at first sight, seem unreasonable to suggest that synthesis of metals is a possibility for the future. It can be safely said, however, that controlled thermonuclear reactions for the large-scale production of metals are not, at present, in the realms of possibility; it would be simpler to carry out mining on the moon.

This, then, is the position. Mineral resources are a fixed quantity and sooner or later, these resources as we know them must, inevitably, be exhausted. We are, and have been, living too extravagantly, disregarding to a large extent our responsibility to posterity. Increasing efforts must be made in all the fields indicated, in order to ensure the maximum conservation of the world's resources. Although it may be that science will adequately meet future emergencies, it is unwise to place too implicit reliance on this.

HOW ATLAS COPCO EQUIPMENT HELPED FRANCE PRODUCE 55 MILLION TONS OF COAL IN 1954

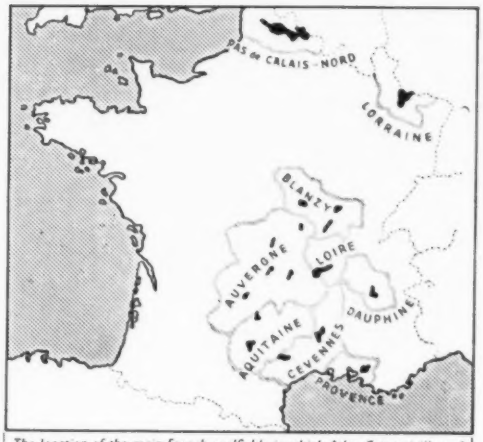
France today is one of the leading coal-producing countries in the world. The progressive modernisation policy of French mining authorities has created an industry that is one of the strongest links in the country's economy. With the introduction of new mining methods, production figures have risen year by year reaching fifty-five million tons in 1954.

Over the last ten years France has started nineteen new mines and modernised many more. In these mines, productivity is the highest in Europe while output per man-shift saw an increase of 55.8% between 1948 and 1954.

GETTING AT THE COAL

The fifty-five million tons of coal produced in 1954 entailed immense development work. It meant the drilling of 125 miles of galleries and the excavation of sixty million cubic feet of rock. With the use of fast and efficient drilling equipment on these preliminary operations, 1954's high production figure was achieved.

To speed development work, French mining engineers brought in the lightweight combination of pusher leg drills and tungsten-carbide-tipped drill steels—a drilling method pioneered by Atlas Copco and Sandvik in the early 'forties. At the present time four thousand of these light rock drills are in operation throughout the French coalfields. Many of them are *Atlas Copco* drills fitted with *Sandvik Coromant* steels.



The location of the main French coalfields in which Atlas Copco drills and Sandvik Coromant drill steels are extensively used

The Atlas Copco light rock drills and Sandvik Coromant tungsten-carbide-tipped steels in use down the mines were supplied by Atlas Copco France S.A., the French company in the world-wide Atlas Copco Group.

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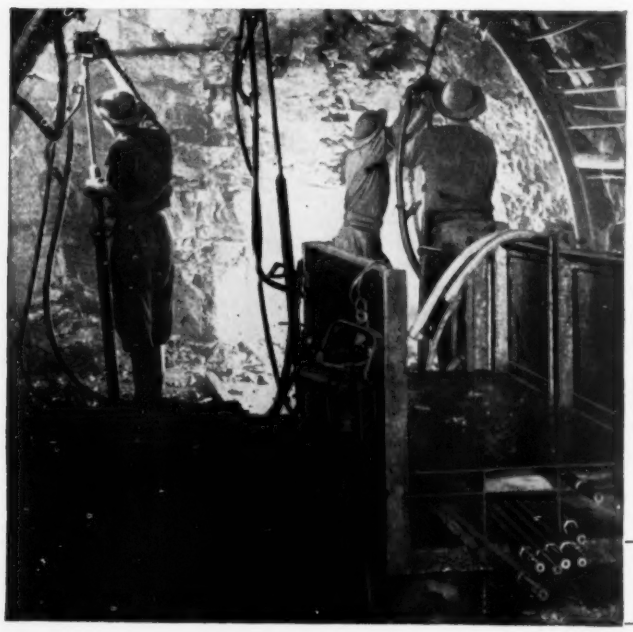
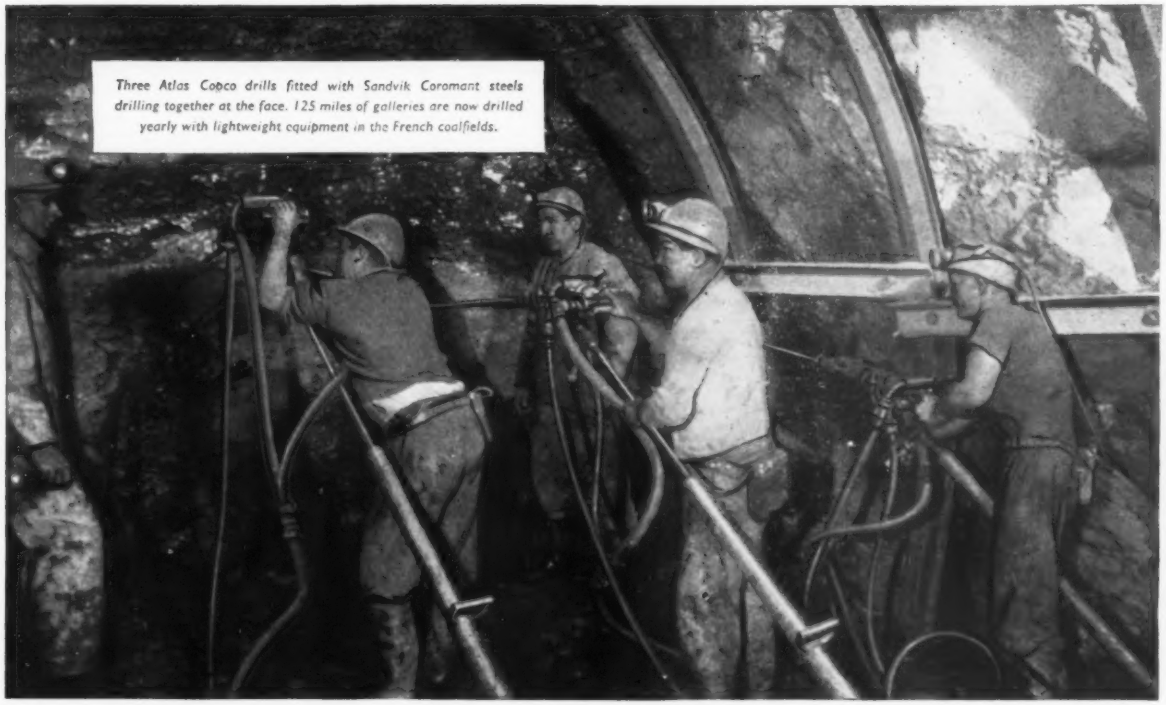


Atlas Copco rock drills on development work down a mine in the Nord-Pas de Calais area. By speeding up development work France was able to produce 55,000,000 tons of coal in 1954.



Three Atlas Copco drills fitted with Sandvik Coromant steels drilling together at the face. 125 miles of galleries are now drilled yearly with lightweight equipment in the French coalfields.

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Atlas Copco light, ***one-man*** *rock drill in action at the Henin Liétard Mine. It is fitted with a Sandvik Coromant tungsten-carbide-tipped drill steel.*

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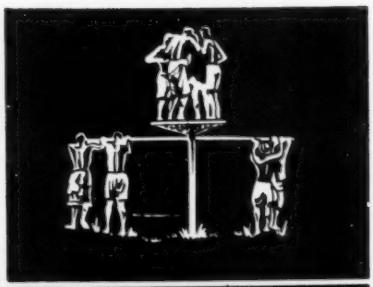

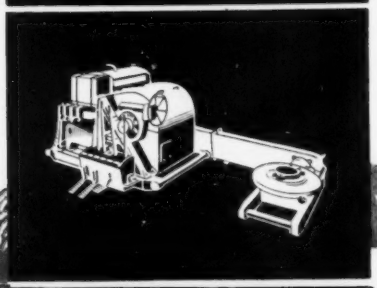

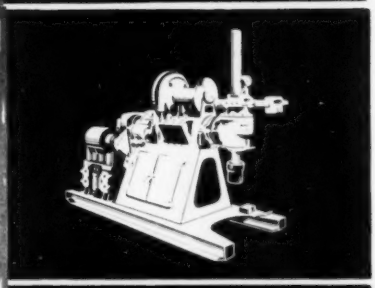

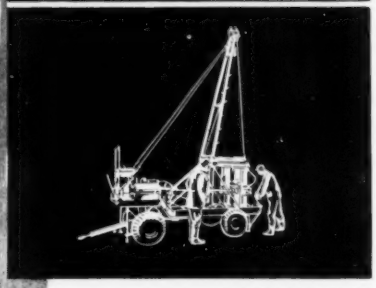

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Mineral Exploration

By D. TAYLOR SMITH, B.Sc., D.I.C., F.G.S.

IT can be said—and said with reasonable conviction—that the future of the mining industry depends upon its exploration programme more than on any other branch of the industry. All new developments or techniques in the mining of mineral deposits depend upon the location of suitable deposits beneath the surface of the earth—what use is the best mining technique if there is nothing to mine? As reserves become lower, the need for exploration becomes greater so that the vast untapped wealth within the earth's crust can be brought to the view of the miner. Unfortunately, as more and more virgin areas of the earth become ravished by man, the chances of locating mineral deposits by normal methods become less, so that the days of the geologist with his hammer and the prospector with his pan are drawing to a close. Yet it is only in comparatively recent times that geology has gained acceptance as a valuable, if not an indispensable aid in the location and development of orebodies.

It was not always so : in the early days the geologist was regarded by the mining man with some mistrust, but as improved methods of applying geological techniques became developed and these, in turn, gave rise to successful drilling programmes, the mining companies came to rely upon the geologist's advice. However, there remain considerable gaps in the geological knowledge of ore deposits even to-day : fundamental questions on the origin of the metals, and on their mode of transport to the site of deposition to form orebodies, have yet to be solved. Arguments still rage on two processes of ore-formation—the theory of hydrothermal solutions and the hypothesis of lateral secretion (or the long-range diffusion theory of some writers)—which are entirely different ; and until some incontrovertible theory of ore-deposition ,is developed, geological methods will remain entirely empirical. At the moment, the mining geologist is hesitant to suggest any programme of drilling until he has seen some evidence of ore, or until he has marked some indications of its presence such as the location of associated gangue minerals. This hesitancy is justifiable, but until the mining geologist is able to make a confident prediction on some basis other than structural, the state of exploration will remain exactly as it is. Thus, the geologist will still require a certain number of rock exposures in order that he can examine the suitability of the environment for the deposition of ore. In the meantime, the ore reserves are running out faster than the sands of time. But vast areas of the earth's surface are covered by superficial deposits—boulder-clay, laterite, etc.—and by water and ice such that geological features are masked entirely. From all points of view, scientific or otherwise, the chances are that beneath these areas large amounts of mineral wealth lie untouched awaiting the drill to descend to prove them.

It would thus appear that the future of the mining industry lies in the development of these superficially-covered areas ; and this, in turn, depends on the development of techniques capable of exploring beneath the surface cover. Thus, the future of the mining industry lies in geophysics and geochemistry.

Geophysics and Geochemistry

Much criticism has been directed against the geophysicist in the past, and much of it was legitimate. Some mining companies were misled by unscrupulous operators into believing that geophysics could solve all their problems ; while, for others, geophysical techniques were not sufficiently advanced to offer a solution. But the blame has not been all one-sided. There have been instances where geophysical surveys have failed due to lack of understanding and co-operation. One of the most common misunderstandings is the actual nature of geophysical work. Too many mining companies think that the work is reasonably easy : they purchase some equipment—say a gravity meter—train operators, and think that they have a geophysical team. In some cases this method has been successful, particularly where the services of a geophysical consultant have been acquired. But most cases have served to underline the fact that instrument operators are not geophysicists : they lack the training and experience in the sciences (physics, economic geology, mining, etc.) that are necessary for a reasonable geophysical evaluation. Another issue on which the mining geophysicist is frequently at odds with mining companies involves their hesitancy to supply geological information.

Geochemistry, the new infant, has been equally mistrusted by many, simply because of its youth. Of course, the various techniques employed in geophysical and geochemical prospecting are not capable of supplying unique and unambiguous answers to all the problems concerning the geology of the mineral deposits beneath the surface : not enough practice has been obtained in them, nor enough basic research carried out to ensure that they are foolproof for all regions. As more different areas become examined, more different problems requiring solutions arise : the best solution can be found only after a great deal of experiment and research.

Oil Industry's Example

These facts were realized thirty years ago by the oil companies. It is said that the introduction of geophysical methods in the search for oil reduced the ratio of successful drilling from 1 in 30 to 1 in 5, a feat at which few can grumble. Of course, the problem in mining is not quite the same : to begin with, in oil prospecting the object sought is on a much grander scale than those structures seen in mining ; and the diversity of the problems in mining is much greater. But this only means that the amount of research in mining geophysics must be increased in order to meet these diverse problems. On this basis, it might well appear it should equal, at least, the research in oil geophysics if only because of the nature of the problems involved. Statistically, however, this is not the case : not more than five per cent of research activities is devoted to the investigation of new techniques of geophysical mineral prospecting, other than oil. This is, indeed, a sorry state of affairs.

The universities, too, have their parts to play in this new thinking on mineral exploration. It is not sufficient these days simply to train good geologists : they must have some appreciation of the new techniques as well. In this light, it is better for the undergraduate to have obtained, in school, a basic training in physics, mathematics, and chemistry rather than in geology, geography, and biology. It is generally agreed that the additional qualifications should be obtained in the student's post-graduate years. In order to avoid a duplication of courses, with the additional expense involved, it is preferable that this post-graduate training should be acquired at one of several centres scattered throughout the country, rather than at the

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student's parent university. A post-graduate course, leading to a Diploma of the Imperial College, is to be inaugurated and it has been arranged that this course will commence in the academic year 1956-57.

Aeromagnetic Surveys

Over the past year probably the most outstandingly successful use of the new techniques has been the location of a large deposit of ilmenite in Norway. To this end an aeromagnetic survey, by a British company, has been completed recently in north-west Norway. The airborne magnetometer was mounted as a " stinger " on the tail of the aircraft, the whole area being flown on a line spacing of 500 metres at a height of 500 ft. above the ground ; in certain areas the spacing was reduced to 200 metres at a height of 300 ft. The flying programme lasted about three weeks and covered an area of approximately 300 sq. miles. From the aeromagnetic maps, and from a study of the geological conditions of the area, it was decided to obtain some confirmation of the evidence by means of a ground magnetometer survey. On the site of one of the aeromagnetic anomalies a drilling programme has been initiated, and it is encouraging to learn that on this first anomaly to be drilled the presence of more than 100,000,000 tons of ilmenite has been disclosed.

The ore is ilmenite - magnetite and is of good quality, assaying 17-18 per cent titanium oxide and 20 per cent iron ; it can be concentrated by magnetic separation to an ilmenite concentrate containing 44 per cent TiO_2 and 44 per cent Fe, with a magnetite concentrate of about 66 per cent Fe as a by-product. Most of this new discovery can be won by open-cast mining.

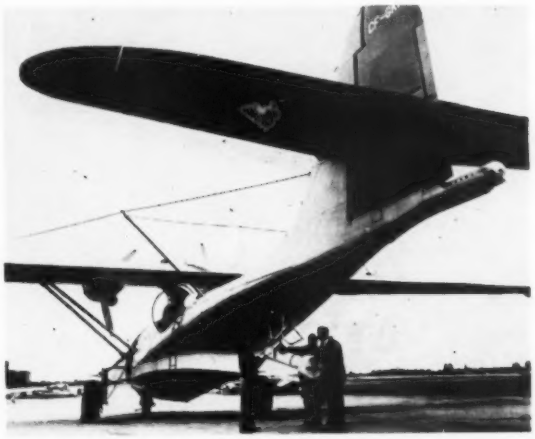

Fig. 1. An external view of the Canso aircraft showing electromagnetic energizing coil and pick-up loop, and the airborne magnetometer head mounted in the tail

In other parts of the world as well, the airborne magnetometer has made its appearance. Apart from North America, surveys have been conducted in Siam, Jamaica, and North Africa. In the search for iron ore on the Australian continent, nearly 6,000 sq. miles have been flown in South Australia and about 4,000 sq. miles in the Northern Territory. A recent survey of 1,200 sq. miles over six islands of the Philippines group has disclosed new sources of iron ore.

A recent development in magnetic prospecting has been the appearance of a new type of magnetometer based upon nuclear magnetic resonance. The protons in the nuclei of certain media (e.g. water, alcohol, etc.), become polarized on the application of an electromagnetic field of sufficient strength, and on the removal of this external field the protons precess into the earth's field ; the frequency of the precession is of a diagnostic value as to the strength and direction of the earth's field. Thus the new magnetometer consists simply of a bottle of water, a polarizing electromagnetic coil, and a pick-up coil to measure the proton precession frequency. Research on this instrument is being continued both in England and overseas. Within the last six months, this magnetometer has been adapted for operation in a light aircraft and is being used, at the moment, in actual surveys for iron ore in Northern California.

Electrical Methods

In electrical prospecting the most noteworthy trend, over the last twelve months, has been the increase in the number of airborne electromagnetic surveys for base metals. The associated photographs show a typical installation on an aircraft fitted for electromagnetic, magnetic, and radioactivity measurements. The transmitting loop is stretched across the wings and the pick-up loop towed behind the aircraft in a " bird ". Measurements are made at two frequencies (400 c/s and 2,300 c/s) (Figs. 1 and 2), and both are recorded simultaneously. The use of two frequencies enables a detection to be made of orebodies of differing electrical conductivities : a poor conductor responds better to a high frequency field, while the reverse is true for a good conductor. The method has shown itself to be peculiarly appropriate to Canadian mineral prospecting conditions ; and in its short history it has been dramatically successful. A major disadvantage of the present E.M. equipment is that it requires the aircraft to fly at a constant height of 500 ft. above the ground, and in regions of extremely irregular topography this imposes a severe strain on the flying crew (Fig. 3). Attempts are being made to adapt the equipment for use from a helicopter by which means it may be possible to overcome this problem.

Promising advances have been made recently with the induced polarization method of locating metallic orebodies. It has long been known that the anode and cathode of an electrolytic cell become polarized upon the passage of an electrical current through the cell. This effect may be made use of in the detection of metallic bodies completely surrounded by an electrolyte. A current may be passed through the ground to cause polarization to occur at the points where the current enters and leaves the body. If the energizing current is suddenly cut off, another current will flow due to the positive and negative poles on the body acting as the poles of a battery. This current, which will flow only for a short time until all the induced energy is dissipated, causes a potential difference to be set up between two points on the surface, and this may be measured. An interpretation of the results leads to the location of the orebody. The effect has been demonstrated, on a model scale, in the geophysical research laboratories of the Royal School of Mines, and apparatus is in the process of construction for the examination of known orebodies this summer.

The " High-Resolution " System

An important modification of seismic prospecting techniques, for mining and engineering investigations, has been the development of " High-Resolution " reflexion recording. In this technique it is found that, for shallow depths, the best reflexion information can be obtained at frequencies much higher than those conventionally used in seismic work. In areas of complex structure the use of high frequencies, with close geophone spacing, has made it possible to map steep dips, overthrusting, and unconformities up to a few thousand feet deep ; such features usually cannot be resolved by conventional seismic

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methods. This advancement should prove to be extremely useful in the detailing of coalfield structures, particularly for the detection of good reflecting surfaces such as sand-filled wash-outs. The HR system has been used, in North America, for uranium prospecting and structural problems involving buried river channels and dykes.

Radioactive Surveys

In the search for radioactive minerals, all forms of exploration techniques have been used. Advances have been made in normal field instruments : the Geiger-Müller rate-meter is being replaced gradually by the scintillation counter. The latter makes use of the fact that various organic and inorganic crystals emit visible ultra-violet light when traversed by ionizing radiation ; and the light flash from each ionizing event can be detected by a photo-electric cell, or some such device. These counters are much more efficient than the Geiger counters, and give a greater discrimination in the detailing of orebodies. The use of scintillation counters in aircraft has been widely advocated, in recent years, as a rapid means of prospecting, and many contracting companies offer this service in alliance with their other airborne techniques. Unfortunately, to date, these airborne radioactive surveys have been, to say the least, a little disappointing. This may be due to the fact that the geological conditions satisfactory for a competent magnetic or electromagnetic survey were not suitable for the formation of radioactive minerals ; or it may have been that the aircraft flying programme was unsuitable for the detection of the radiations. Geochemical prospecting has proved invaluable in delimiting areas for more detailed study. In regions difficult of access (rugged terrain, dense forest, etc.), quantitative determination of the uranium content of the drainage waters produces a successive delineation of the river basin and then of the tributary valley in which the uranium mineralization occurs. It is possible, now, for these tests to be carried out in the field with a minimum of equipment.

Fig. 2. Canso aircraft making a combined aeromagnetic and electromagnetic survey over heavily-wooded country. The electromagnetic pick-up loop is towed in the "bird" behind the aircraft

Courtesy: Hunting Geophysics

Spectrographic Analysis

In recent reconnaissance work in northern Maine, a spectrographic analysis of lake waters revealed interesting data regarding the mineralization of the region. The situation was ideal : heavily wooded country with few geological exposures, and having no contamination of drainage by industry. The data for twelve elements normally present in trace amounts in natural waters—Cu, Pb, Zn, Ag, Sn, Ni, Cr, Mn, Mo, V, Zr, and Ti—were evalu-

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Fig. 3. The output of the E.M. equipment and the aircraft's altitude are recorded simultaneously, while a continuous strip camera exposes a photographic record

ated by studying their variations from lake to lake. It was found that by plotting the results (weight percentage concentration in evaporated water residue) for each element on a map of the region, lakes with higher values formed groupings which represented localities of greater possibility for mineralization. In one particular section, the use of the drainage pattern technique delimited zones of Pb, Zn, Ag, and Cu mineralization in an area as small as 40 sq. miles ; these were then examined by other, more detailed methods such as soil analysis.

In order to increase the efficiency of geochemical spectrographic work, the U.S. Geological Survey has developed a four-channel X-ray spectrograph so that a determination of four different elements can be carried out simultaneously. For rapid spectrographic analyses in the field they have designed, also, a spectrographic laboratory which can be mounted on a truck. The laboratory carries complete equipment for the making of qualitative and quantitative analyses of geological materials. The usefulness of it may be seen in its extreme mobility : it takes less than two hours, after its arrival at field camp, to be a functioning unit.

Elsewhere in the world—Nigeria, the Gold Coast, Rhodesia, Canada, etc.—research work is being conducted using new techniques, drainage patterns and cold extraction, as well as the conventional geochemical analyses.

The recent formation of the United Kingdom Metal Mining Association, to encourage the mining of metals and minerals in these islands, indicates that some people are, at last, beginning to worry about the state of the industry. A certain amount of prospecting has been organized by this association, particularly in Anglesey, Lanarkshire, and the Isle of Man, using geophysical and geochemical techniques as well as normal methods.

The fundamental approach has been, and always will be, geological ; the new techniques are simply more elaborate tools for the geologist to use. But without these tools the future of mineral exploration is obscure, to say the least.

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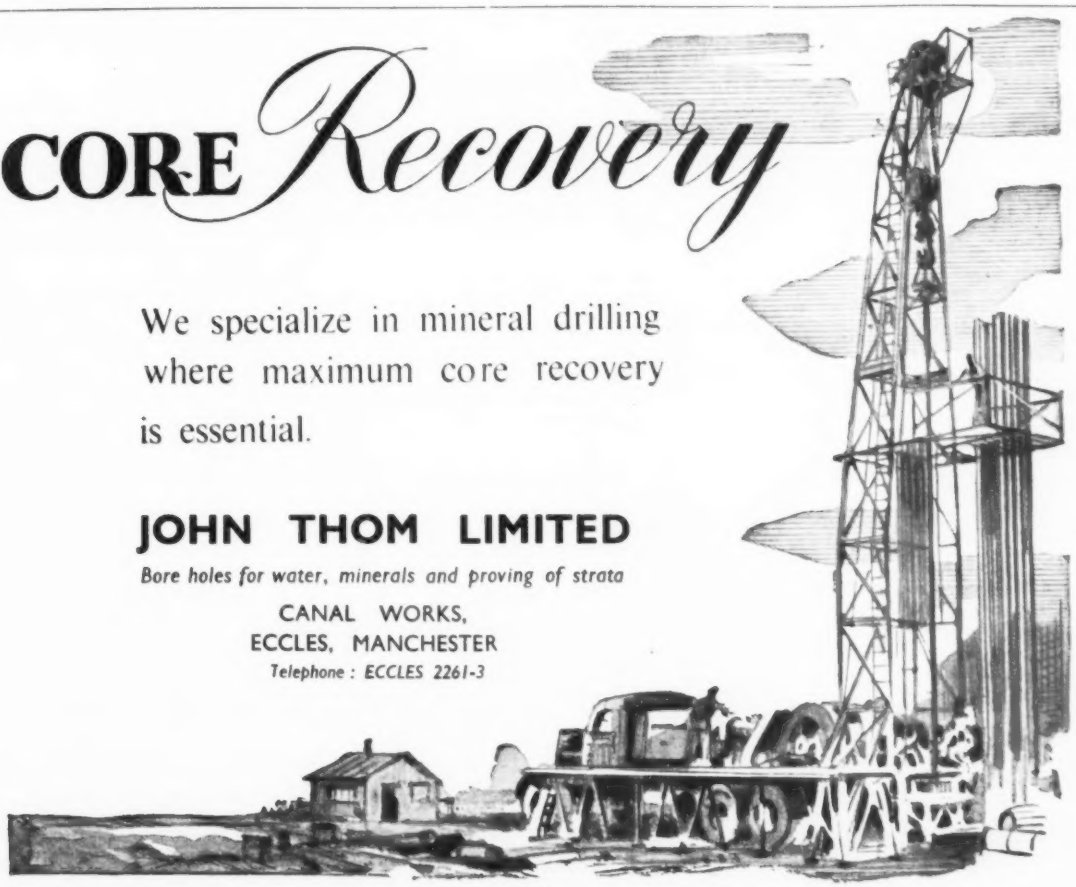

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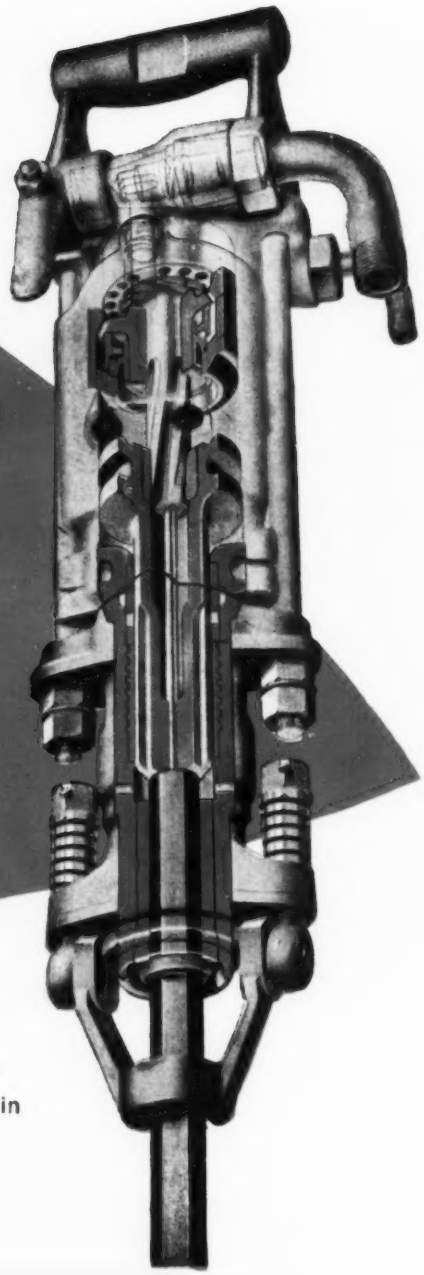

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Underground Mining

By A. GRIERSON, B.Sc., A.M.I.Min.E. and D. SUTTON, B.Sc. A.R.S.M., A.M.I.M.M.

WITH no slackening in the world demand for minerals, the mining industry is facing resolutely the challenge of expanding outputs with limited labour forces. In all its phases, machinery is coming more to the fore and is replacing hand labour in operations where mechanization was formerly thought impracticable or uneconomic. The true potentialities of old techniques are being more fully realised and new methods are constantly under review.

Drilling—Larger or Smaller Holes?

In recent years intensified research work and field experience have together gone far towards maximising drilling efficiency. The capabilities and limitations of existing equipment and techniques have been more clearly defined and closer investigation of new methods continues.

It should be mentioned at the outset that only in such operations as exploratory drilling or rock bolting should drilling efficiency be assessed solely in terms of cost per foot of hole. Interplay of factors such as hole size, speed of penetration, burden and fragmentation demands that efficiency be assessed in terms of cost per ton broken in stoping or cost per foot advanced in development work. In particular cases the relative costs of labour and explosives often dictate the technique to be adopted for achievement of greatest overall economy.

Size of hole is a variable factor under constant investigation in both production and development work. Broadly speaking, larger holes in stoping operations give lower cost per ton broken, provided facilities are available for handling the larger size of material which inevitably results even with millisecond blasting. Increasing hole size reduces drilling cost per ton, but explosive efficiency falls off and secondary blasting charges rise, so that for overall economy the effects of several variables must be weighed one against the other. In hard rock and using conventional equipment holes from 2 to 4 inches in diameter can be drilled with acceptable speed and cost.

In development work where on account of confined space the burden which can be placed on a hole is limited, holes of normal size are from a blasting standpoint often too big for the job and are capable of replacement by an equal number of smaller holes. Since penetration speeds for a given machine vary inversely with the square of hole diameter, small diameters would at first appear an obvious choice, and for this reason some $\frac{1}{4}$ in. steel is actually being tried. However, the process cannot be carried too far. Explosives will not detonate properly if cartridges are below $\frac{1}{2}$ of an inch in diameter, and percussive drill steels made of the finest alloy available fail to give satisfactory service if made smaller than this.

At one Canadian mine, where $\frac{7}{8}$ in. hex. integral steel is standard in development work a change to $\frac{3}{4}$ in. hex. steel gave holes too small for consistent easy loading with $\frac{7}{8}$ in. powder and safety fuse. The smaller steel is now used only to improve penetration speeds in exceptionally hard ground.

Machine size, of course, governs the upper and lower limits of hole size, and is itself governed by the rate of penetration required for a given size of hole. Bigger machines mean bigger steel, and larger holes must be drilled to accommodate the steel. However, despite the unavoidable increase in hole size, rates of penetration increase with increasing size of machine.

Drill Steel

Largely through improper treatment, the performance potential built into modern hollow drill steel by the manufacturers is seldom realized in the field and drilling costs in consequence are often unnecessarily high. It has been stated that in percussive drilling with alloy steel rods and TC bits the capital cost of rod and bit per foot of hole drilled is approximately four times the combined capital and operating costs of the machine. Premature failure of the drill rod occurs only too frequently and points to the rod as the weakest link in the drilling combination.

Expensive alloy steels call especially for correct and carefully controlled drill shop practice, and repay increased treatment and quality control charges many times over.

At the Calumet and Hecla Centennial mine, rod failures continually occurring at rod ends suggested poor or inadequately controlled drill shop practices. An investigation was set afoot which resulted in modification of heat treatment to reduce metallurgical notches, and oil quenching was substituted for air blast hardening. This, together with implementation of a quality control procedure, increased the average life of $\frac{7}{8}$ in. hex. airleg rods from 98 ft. to 313 ft.

Tests carried out by the Climax Molybdenum Company have indicated the possibility of a 500 per cent increase in the service life obtained from their $\frac{7}{8}$ in. hex. alloy drill steel. Revised, closely controlled and consistent heat treatment gives up to five times original life on a 6 ft. rod, and use of a minimum radius of $\frac{1}{8}$ in. at collars has eliminated collar failures entirely. Original rod life with $2\frac{1}{4}$ in. autostopers was 92 ft. This has now increased to 471 ft.

Shot peening, applied as the final operation in drill rod manufacture can appreciably reduce rod breakages and a recently introduced process known as "spiral rolling" may prove even more effective. Both processes are applied in the cold state to heat treated portions of alloy rods with associated metallurgical notches, and are effective in improving the physical properties of the metal as regards resistance to fatigue. Field tests have shown the footage drilled by both shot peened and spiral rolled rods to be several times that obtainable from steels not so treated, but precise indications of the possibilities of these methods in reducing overall costs have yet to be given.

Bits and Bit Attachments

Evidence indicates that in very hard or abrasive ground integral TC steel shows marked advantages over any form of detachable bit. Where rod life is a multiple of bit life, re-tipping the steels with new inserts is an economic solution to the problem of unused steel and is successfully undertaken at several properties.

In abrasive ground where gauge loss limits bit life, integral steel has the important advantage of smaller discard gauge, and in all types of ground absence of an attachment device eliminates one source of failure. Steel transport is minimised by re-conditioning underground either in central shops or by light, readily portable grinders in individual working places.

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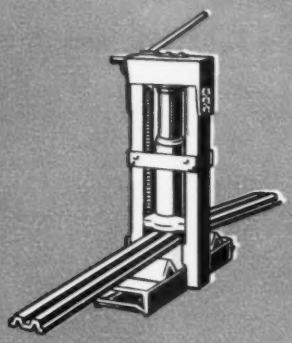

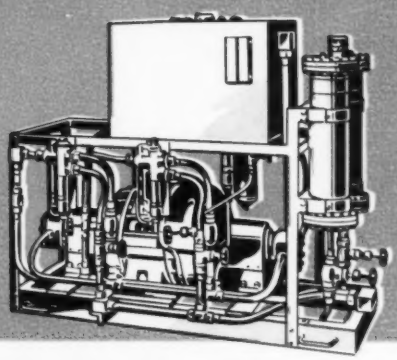

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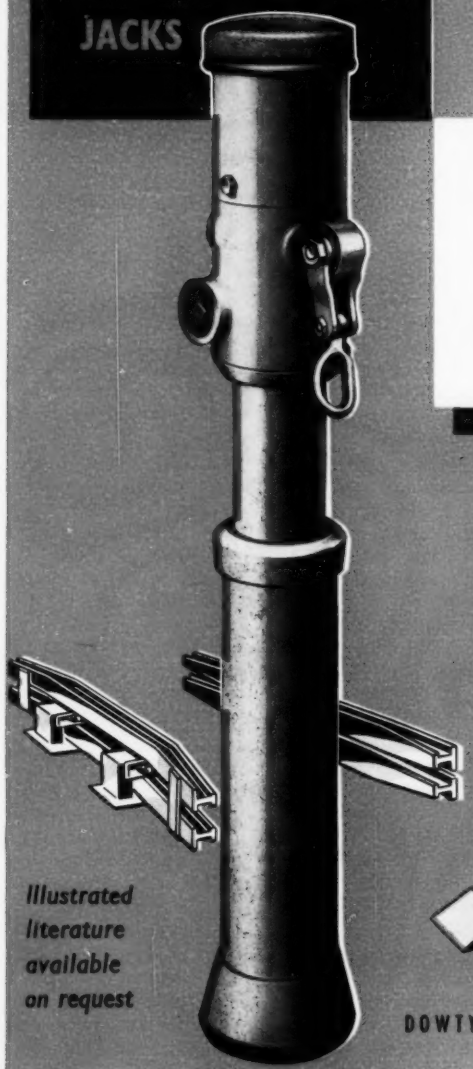

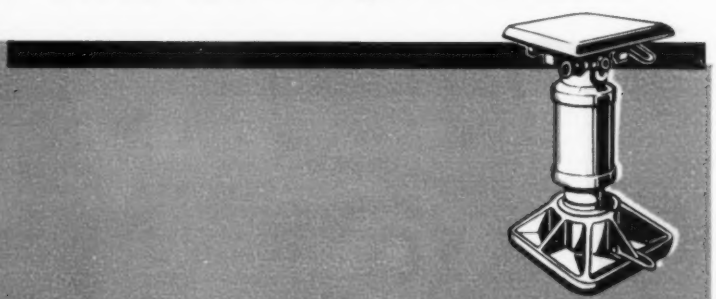

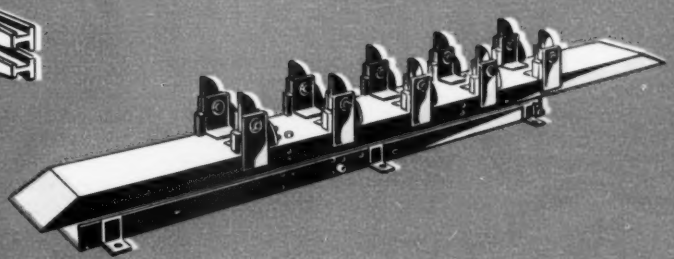

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In Canada, however, the overall use of carbide-tipped integral steel is decreasing in favour of detachable bits, although here as elsewhere the true position is obscured somewhat by the subsequent use with detachable bits of integral steel rods which still have useful life after the TC inserts have become worn out.

The conical form of attachment is gaining in popularity over the threaded type, which is more expensive to make and more prone to failure. Use of a soft metal thimble over the tapered rod end is useful in reducing fretting and loosening of the bit, but its thickness should be limited to about 0.005 inches for best results. Knurling the rod-end taper gives a really solid and durable attachment when used with thin metal or even paper thimbles.

According to Carruthers, who reports from Mount Isa, many TC bits available in Australia show faulty design. Inserts should be at least $\frac{5}{16}$ in. wide by $\frac{1}{2}$ in. deep for economic performance.

Rotary Auger Drilling in Harder Rocks

Rotary auger drilling is extending into the harder rocks and finds increasing use where, through improper application, the method was hitherto considered unsuitable. Shales, gypsum, some iron ores and moderately hard sandstones are now drilled by rotary auger-type equipment and, where satisfactory bit performance can be obtained, the method is unrivalled in giving high penetration speeds at low cost. Further extension of rotary auger drilling into the harder rocks is prevented at the present time by insufficient resistance of tungsten carbide tipped bits to wear and shock loads under the extremely high thrusts necessary.

Auger bits up to 8 inches gauge and of somewhat complex design have been used successfully in burn-cut drifting, but those in more general use have gauge sizes around $1\frac{3}{4}$ inches and are either pronged or of the spade-head type. Self-cleaning scrolled rods are standard, although hollow, smooth round rods with water or air flushing give rather better results. Penetration speeds up to 20 ft. per minute in shales and sandstones are not uncommon with an average of about half this figure.

Recently TC bits of the non-coring spade-head type have been used with conventional diamond drilling machines and rods in exploratory work and have given encouraging results in soft to medium-hard rock.

Proper application of equipment is essential to the success of rotary auger drilling. Low rotational speeds with high thrusts are required in hard rocks, while higher speeds with lower thrusts give better results in softer rocks.

At the White Pine mine, Michigan, a twin boom rotary drill jumbo has been developed for small-hole drill-drilling in sandstone and shale. Best penetration speeds are obtained when the drills are operated at 300 r.p.m. and 5,500 lbs. of applied thrust, under which conditions the average life of a 2- or 3-prong bit is 400 feet.

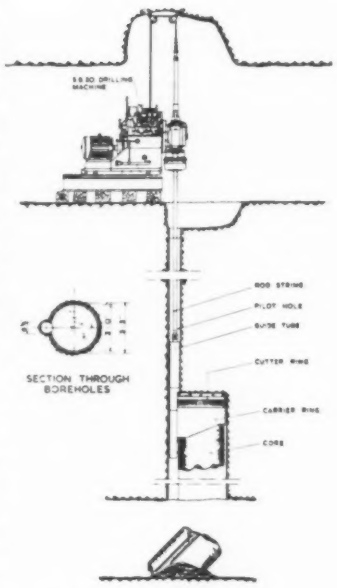

Fig. 2. The Salzgitter core ring borer

Drilling in sedimentary iron ores at the Dragonby mine, Scunthorpe, is by electrically driven augers mounted on rubber-tyred jumbos of advanced design. Operated by one man from a portable push-button panel, a machine drills at any required angle within an area 24 ft. wide by 18 ft. high. Some 43 or 44 holes $1\frac{1}{8}$ in. in diameter are completed to a depth of 10 feet in $2\frac{1}{2}$ hours, which represents an actual speed of penetration of 4 feet per minute. 11 foot scrolled rods are used in conjunction with pronged bits.

Jumbo-Mounted Drifters

For high-speed level driving and in room-and-pillar mining jumbo-mounted drifters have been holding their own with airleg competitoin. Jumbos mount heavier machines which drill at higher speeds and require less labour than their airleg rivals. More accurate hole alignment is possible and centralisers assist in prolonging rod life.

On many modern jumbos positioning of the machines is fully automatic under the control of double-acting hydraulic cylinder mechanisms. Spanner work is still required for machine alignment, but has been reduced to a level at which the complexity of further automation is not warranted. A 4-boom hydraulic rig for use in ends up to 14 ft. wide by 12 ft. high is illustrated (Fig. 1.)

The trend is towards self-propelled units mounted on rubber tyres, where applicable and in large scale work made integral with the compressor. Many manufacturers are centralizing controls in the interests of labour economy, and the use of long cradles to reduce or eliminate steel changes is becoming universal.

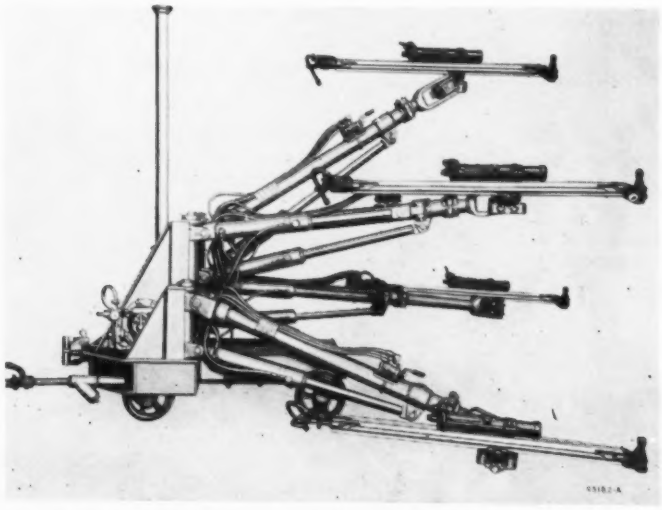

Fig. 1. A four-boom Jumbo with extendable booms and double acting lift and swing cylinders.
Courtesy: Ingersoll-Rand

Airleg Drilling

The virtues of airleg drilling have been greatly enhanced by the development of light 3 in. bore

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machines with high drilling capabilities. It is worthy of note that airleg machines were used exclusively in the high speed development work reported from Scotland and South Africa within the past 12 months, but it must be borne in mind that suitably designed jumbos might well enable performances to be improved still further.

Experience in the use of both airleg machines and boom-mounted drifters at the Eagle Pitcher Tri-State mines may be quoted as typical. Here airleg drills are found most useful in small scale exploratory and other work where column or tripod-mounted drifters were formerly employed. General production drilling continues to be done with jumbo-mounted drifters, 2½ in. bits and 1¼ in. steel. Labour cost per ton is about twice as much with airlegs as with jumbo drilling, and so many more airleg machines would be required for equivalent output that increased compressor and repair facilities would be required if a complete changeover were effected.

The general conclusion is that, aside from longhole work, the airleg is superior to the column mounted drifter but in accessible places the jumbo has decided advantages.

Large Hole Boring in Coal Mines

The need for many auxiliary ventilation and access shafts in the horizon system of mining has stimulated the development of equipment for the drilling of large diameter boreholes. A typical European example is the Salzgitter core ring borer. This can be used to drill large holes up to 3 ft. 3 in. diameter between underground levels. As indicated in Fig. 2 a pilot hole of 8¾ in. dia. is drilled between the levels. A drill unit located in the upper level drives a rod string rotating inside the pilot hole. Attached to the lower end of the rod string is a pinion which meshes with teeth cut on the periphery of a hollow carrier ring carrying a cutting element fitted with detachable picks. As the rod string is retracted and rotated, the cutting element cuts out a core of rock which after breaking falls to the lower level for subsequent removal. An alternative model utilises a specially designed motor which fits into the pilot hole and drives the pinion direct. This dispenses with the need for a solid drill string and the entire equipment is suspended in the pilot hole by a non-spin rope. This rope is then hauled up by a winch in the upper level.

Another machine is the Bade staple shaft borer designed for drilling holes up to 5 ft. diameter. This is a roller bit machine powered by a built in 70 kW. motor connected by a two speed gearbox to the cutting head. The entire unit is pulled up between levels by a rope hanging in the pilot hole or alternatively by solid rods lifted by a hydraulic ram located in the upper level.

Caterpillar tracks on the cutting head guide the machine in the hole. These are driven by the same motor that drives the cutting head. The cutting head rotates eccentrically about the central axis of the machine and is fitted with three crowns each having four hard metal, toothed, roller bits. The rotation of the bits cuts out a core of the requisite diameter and the cuttings and the core are loaded from the lower level after falling. When the cutting head and the motor are suspended by a rope the normal winch pull is 15 tons. This is found to be adequate for soft strata but for harder rocks a solid rod string and hydraulic ram system of lifting is recommended.

Longhole Prospecting and Production

The trend towards the use of sectional steel and TC bits is accelerating, especially in very hard or abrasive ground. This is due entirely to lower cost. Drilling speeds with the percussive method are higher and the price of industrial diamonds has increased 2½ times in recent years.

Percussive methods do not, however, show as large a saving in the deeper holes. One authority states that TC drilling is most economical in drilling blast holes under 100 ft. in length and BX (2⅜ in.) diamond drilling beyond this length. The tendency is to change stoping layouts so that percussive drills can be used more extensively.

At the Sherritt Gordon nickel-copper mines, a change from AX (1⅞ in.) diamond drilling to 2 in. percussive drilling of blastholes resulted in an increase in tons broken per machine-man shift from 148 to 254.

Diamond drilling is often the only reliable method of longhole prospecting, but where the ground is very hard or abrasive diamond cost is high, investigation of percussive methods is warranted especially for depths less than 100 ft.

In several of the Tri-State mines the highly abrasive nature of the rock has led to the adoption of percussive longhole prospecting. At the Big Chief mine airlegs are used with ⅞ in. hex. extension steel and 40 mm. TC chisel bits for holes averaging 30 ft. in length. At other mines in the district column and jumbo-mounted drifters drill 2 in. to 2⅜ in. prospect holes up to 90 ft. in length. Loose and open ground causes poor cuttings recovery in down holes and experiments are under way with dry drilling and dust collector sampling.

Percussive longholing for sampling and stoping at the Gold King mine, Wenatchee, proved much cheaper than diamond drilling in ground containing quartz veins.

Percussive Drilling Still Costly

Despite improvements in the quality of drill steel and in equipment design, the cost of percussive longhole drilling remains about eight times that of ordinary drilling. The principle of energy transfer along a flexing column of steel containing many joints is inherently ineffecient and encourages fatigue failure. Adoption in the future of the vibro-rotary method of drilling in longhole work may well come about. A compact percussive "down the hole" drill operated at air pressures several times those currently in use would be another possible solution

Blasting Trends

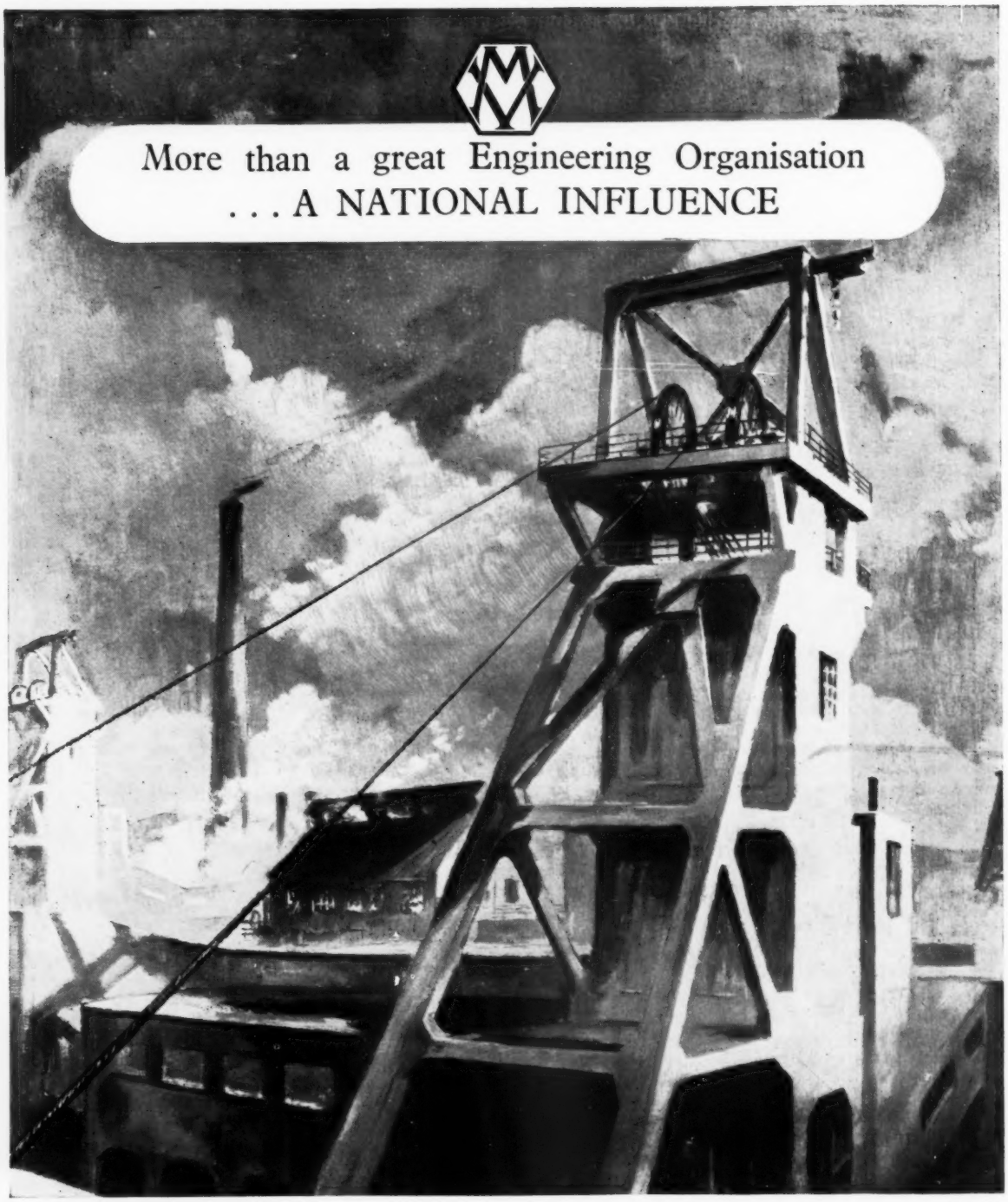
Blasting with short delays gives improved efficiency in the use of explosives and is attended by other important advantages.

Use of millisecond delay electric detonators in underground operations continues to increase and reports are consistently favourable.

Short Delays in Shaft Sinking. It has been found in shaft sinking operations that with short delay blasting greater control is possible over rockpile contour, and that the looser rockpile which results also facilitates loading. This factor is of increasing importance as mechanical loading is applied to a greater extent in sinking projects. Alternate delay numbers are often used in the outer ring of holes to ensure cleaner-cut sides and also to reduce overbreak.

Short Delays in Development Work. In drifting operations short delay blasting gives improved fragmentation and cleaner cut backs and walls, but there is a tendency to produce long, low, rock piles. This may be advantageous where scraper-loading and airleg drills are used.

Dominion Steel and Coal Corporation use millisecond blasting at their mines in Nova Scotia for drifting through water-bearing coal measures. Replacement of ¼ sec. delays by millisecond delays in 18 ft. dia. semi-circular ends has resulted in a 25 per cent reduction in explosive consumption, ability to pull longer rounds consistently so speeding



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up advance, improved fragmentation and greater control over shape of rockpile together with neater trimming of back and sides with less overbreak.

The overbreak factor is especially important in ground requiring support since consistent breaking to a neat size means less concrete or timber packing and materially reduces costs.

Short Delays in Stoping. The use of short delay blasting in longhole mining is well known. Even in short hole work advantages in lower overall blasting costs are apparent and millisecond delay blasting is advancing into this sphere also.

At the Mineral Hill copper mine, Arizona, use of millisecond delays in shrinkage-scraper stopes resulted in much finer fragmentation with a corresponding saving in each phase of handling thereafter. Holes were 6 ft. in length.

Blasting Efficiency

Often in the excavation of ground by explosives, the blasting phase is the least efficient in the whole cycle of operations. It is important that full use be made of each and every hole drilled and that more holes are not drilled than are absolutely necessary.

Poor tamping of explosive is one factor which makes drilling costs higher than necessary through poor utilization of available drill hole volume. Use of long explosive cartridges is advantageous and has improved concentration of charge by as much as 25 per cent, thereby decreasing the number of holes required. At Malmberget, Northern Sweden, cartridges 4½ ft. in length have been used in 1⅞ in. dia. holes with favourable results, but there is some danger of losing holes through cartridges becoming stuck.

A new approach to the problem of rapid and complete loading of long blast holes has been made by the Nitroglycerin AB, Stockholm, who have developed an efficient pneumatic loading apparatus (Fig. 3). This consists of a tube of brass or aluminium alloy made up in sections which can be screwed together and pushed to the bottom of the hole. The front end of the tube is fitted with a throat which carries, evenly spaced around its periphery, three stainless steel knives pointing inwards. Explosive cartridges slightly less in diameter than the tube are loaded at the rear end, which is subsequently closed with a close-fitting flange. Air under pressure is admitted through a small orifice in the flange connected via a valve and a length of ¼ in. hose to the ordinary compressed air supply. Operation of the valve causes the cartridges to be forced

Fig. 3. Charging the pneumatic loading apparatus
Courtesy: Nitroglycerin A.B. Stockholm

along the tube until the foremost reaches the throat. Here it acts as a plug in the opening, the pressure in the pipe rises and the cartridge is extruded with the knives cuting longitudinal slits in the wrapper. If at the same time the tube is given a slow inward and outward movement a hole completely filled with explosive results.

This pneumatic loading apparatus has been used in Sweden over a period of several years. It enables 40 per cent more explosive to be placed per hole than with long cartridges, which is important in increasing toe burden in long blast hole rings, so reducing the number of holes required per ring and increasing the tonnage broken per foot of hole.

Malmberget reports 25 per cent more explosive loaded with the apparatus per man shift in long hole mining than was formerly possible with long explosive cartridges and ordinary pole tamping.

One further advantage of the method derives from the fact that the loading tube may be appreciably smaller in diameter than the drill hole, so reducing the risk of incompletely loaded holes where movement subsequent to drilling has taken place. A 1¼ in outside diameter tube using 1 in. explosive may be successfully used to load 2¼ in. holes.

Longhole Pulsed Infusion Blasting

Water infusion, either as a means of dust suppression or to facilitate the working of coal, has been standard practice in many parts of the world for several years, but it is only comparatively recently that the process has been carried a stage further and the infused water used to transmit gaseous pressure. The efficacy of water as a means of transmitting pressure impulses is well illustrated by the destructive effect of depth charges at sea.

In Europe and North America trials have continued over the past year using the long-hole blasting/infusion technique as a means of winning coal. With this system a borehole is drilled in the solid coal parallel to the face and some 4-5 ft. ahead of it. Specially developed water resistant explosive cartridges are then inserted at intervals along the entire length of the borehole, the cartridges being connected by detonating fuse. One end

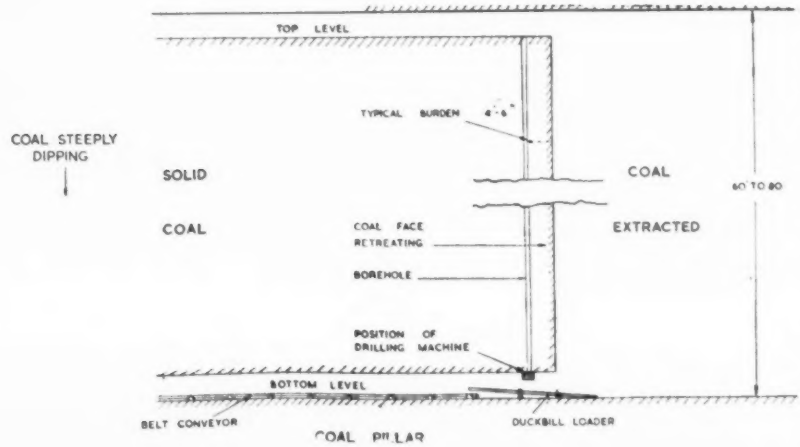

Fig. 4. Pulsed infusion blasting

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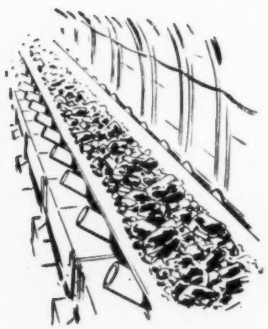

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of the hole is firmly sealed by a plug and an infusion tube is inserted in the other end. Water is then applied until the pressure in the hole builds up to that required. Whilst retaining the tube in the hole the charge is fired and the gaseous pressure is transmitted to the water and so bursts down the burden. Much work has gone into the evolution of the explosive used in pulsed infusion blasting and explosives have been developed capable of efficient detonation under water pressures up to 1,000 p.s.i. Submarine type electric detonators are used and these are placed in the cartridge next to the infusion tube—three to four feet from the mouth of the hole.

The difficulty of maintaining drill hole alignment has so far limited the length of face which has been worked by longhole infusion blasting, and the longest face so far is about 50 yds. in length. Thus the application of pulsed infusion in longholes in seams of normal thickness and gradient is of limited value, but there are possibly three categories in which it would appear to be of considerable advantage and to be worthy of continued experiment.

1. In very thin seams it has been thought possible to operate manless faces by using scraper box ploughs, but this method requires soft coal and straight faces for successful application. By using longhole drilling these difficulties may be overcome and considerable headway has been made with this method in a 12 in. seam in Durham.

2. In steeply inclined seams where the entire face may be fired and subsequently loaded from the lower level. (see Fig. 4.)

3. In pillar extraction where the length of face is within the limits of drilling accuracy.

Pulsed infusion blasting is generally still in the trial stage but there are successful practical applications of each of the three categories mentioned.

High Speed Development

During the past 12 months stimulating achievements have been made in the sphere of high speed drifting. Reports coming from Scotland and the Orange Free State have much in common and serve to illustrate the seldom realised possibilities inherent in conventional equipment and techniques.

In the North of Scotland Hydro-Electric Board's expansion scheme, the average advance in each of the rock headings driven on the whole scheme to date corresponds to a monthly figure of about 800 feet. Best performance so far is reported from the St. Fillans 4H tunnel where, under ideal conditions, an advance of 557 ft. was achieved in 7 days. This tunnel measures 8½ ft. by 8½ ft. and is through a hard micaceous grit.

At the Harmony gold mine, Virginia, OFS, in a 10 ft. by 11 ft. heading through hard, abrasive quartzites, 1,394 feet was driven in 26 days. Rock temperature here was 104 deg. F and pilot hole cover had to be provided 12 ft. in advance of the face. With improved ventilation and loading facilities it is estimated that this figure could be raised to upwards of 2,000 ft.

Three in. bore airleg machines were used in both these record achievements. Rocker shovels were also used in both cases with car-switching behind the loaders.

Thus with few exceptions, conventional equipment and techniques have been used throughout, the speed at which work has progressed being attributable in large measure to advanced organization and close co-ordination of effort between administration and men.

Increased attention is being paid to integral drilling and loading units and to multiple car loaders which enable a round to be cleaned in one continuous operation without delays due to car switching. It seems likely that all these features will be included in future high speed development work.

Trackless Metal Mining

Adoption of the more flexible and less labour consuming trackless methods of mining in other than coal deposits is accelerating.

One of the pronounced trends in this connection is towards more general use of the gathering-arm loader, with shuttle car transport between loader and ore-tip. This combination now finds application in the large scale working of salt, potash and bauxite deposits, together with iron, copper and lead ores.

Gathering Arm Loaders. Recent design improvements have extended the use of the gathering arm type loader into heavier, more abrasive material. These machines have high output for their comparatively small dimensions and are unrivalled in confined workings under suitable conditions.

Loaders are crawler or tyre-mounted and can load continuously at 10 to 12 tons per minute in 7 ft. headroom. However they have numerous moving parts, and maintenance costs in wet, abrasive material can be excessive. Experience in Nova Scotia has shown them to be unsuited to digging consolidated rock piles, or to handling large material.

At the Dragonby mine, two Joy 18HR2's have loaded 9,475 tons of iron ore in a 40 hr. week, which represents an average machine capacity of almost 600 tons per shift. At Kiruna, outputs from a single 18 HR2 serviced by two shuttle cars are expected to approach 1,000 tons of magnetite per shift.

In 15 ft. headroom output of rival equipment in ore of equal density would be approximately as follows:

50 h.p. 3 drum slusher	250	tons per shift
1¼ cu. yd. scoop shovel	550	„ „ „
GISMO	600	„ „ „
Eimco 105 rocker shovel	700	„ „ „

Shuttle Cars. Shuttle car installations are increasing in metal mines. Diesel or diesel-electric units are, however, limited to areas with ample ventilation, while battery-powered or cable reel types have a limited operating range.

Shuttle cars used in drifting operations, have handled up to 18 tons without delays for car switching.

Diesel-electric units have the greatest possibilities with their extended range and may eventually replace conventional truck haulage.

Diesel Power. The successful development of underground trackless mining is largely dependent upon acceptance of diesel powered units as safe and efficient.

Use of diesel power is growing, its application being limited solely by ability to provide adequate ventilation. 75 c.f.m. of air per diesel horsepower is considered a minimum requirement. Diesel units are self-contained, simple to service, and relatively low in operating and first cost.

Coal Face Developments

Continuous mining is now firmly established in all major coalfields and the complex machines are no longer considered as novelties but rather as ordinary workaday tools. In America, where mechanized loading accounts for almost 90 per cent of output, the rapid development of mechanized mining has been dictated by pure economics and not so much by increased demand for coal. In the highly competitive fuel industry of North America the yardstick of success is not primarily tons per manshift but profit per ton. Thus continuous mining must not only give abundant coal but also cheap coal. A machine capable of giving 50 tons per manshift is not an

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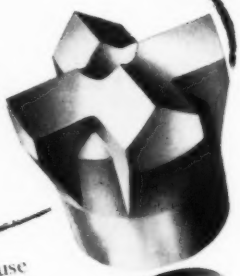

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unqualified success if the coal is so broken up that cleaning costs are high and selling difficult.

With many continuous miners much of the energy consumed is wasted in excessive breaking up of the coal. Tests carried out on a typical rotating chain continuous miner have shown that 230 kW. were consumed per 100 tons of coal produced, this comparing with the 30-80 kW. used in conventional longwall mining with handfilling and explosives.

The corresponding figures for a ploughed face showed that only 2 kW. of energy is consumed per 100 tons output. Even allowing for the fact that the ploughing results were obtained in soft coal, the figures indicate one striking advantage of a slicing action as compared with the tearing action of picks. There is in addition the supreme advantage that ploughing causes far less degradation to the coal. The development of slicers capable of working in harder coal is under way in many countries and, indeed, the general trend of the past year has been more towards the improvement of existing continuous miners of all types rather than the development of revolutionary new machines.

One new machine that was brought out during 1955 is the Wilcox continuous auger miner. This is a very compact machine capable of working thinner seams than most of the contemporary continuous miners, many of which are so large as to be of very limited application. Normal auger mining consists of boring large diameter holes up to 150 ft. in length by adding successive lengths of auger drill, the coal travelling back along the scroll to a static machine. This system has been used extensively for working outcrop seams and to a limited extent underground.

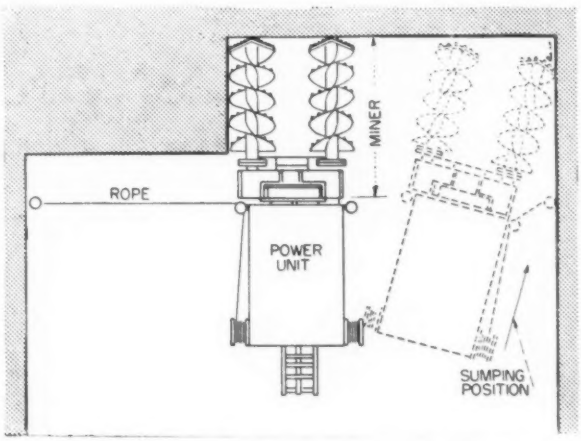

Fig. 5. Diagrammatic illustration of the working method of the Wilcox auger miner

The essential operating difference between the Wilcox miner and the usual type of auger machine is that in the Wilcox miner the auger is of constant length and the entire machine moves during loading. Basically the miner consists of three elements, the power unit, the loading head, and the discharge conveyor, all mounted on a steel base plate to facilitate movement during operation and flitting.

The power unit is essentially a conventional Goodman shortwall coal cutter with the jib removed and replaced by two parallel augers each 42 in. long. Bits are fitted around the scroll edges of each auger which, when the augers are rotated and forced into the face, cut out a cylinder of coal. This is broken up and passes down the scroll to a gathering chain and thence to the discharge conveyor at the rear of the power unit. As will be seen in Fig. 5 the machine operates on the well known shortwall principles, in that it is sumped in on one side of the room and the haulage unit on the cutter body is used to pull the machine across the entire width of the heading. The augers are individually positioned in the required horizon by means of hydraulic jacks and in addition to rotating they are given a short reciprocating motion, which assists in breaking up the coal and prevents binding. The normal working position is to have one auger higher than the other, giving a maximum effective thickness of cut of approximately 1.5 scroll diameter. Thus with 24 in. dia. augers the face height ranges from 26 in. to 36 in. and with 30 in. augers, 32 in. to 46 in., and so by raising or lowering one or other of the augers the operator can compensate for changes in seam height.

Such a relatively simple and compact machine possesses many desirable features. It is much less expensive, both in capital and maintenance cost and as such is ideally suited for small mines. It is claimed that a three-man team can produce 150 tons per manshift with the Wilcox miner and this from seams which, because of height limitations, are difficult to work by existing continuous mining machines.

Scram Drives

Experience with horizontal ore transport in scram drives is by no means universally favourable, and the overall picture is somewhat confused.

Used in caving projects, scram drives replace lengthy gravity passes, and can lead to increased production with improved recovery through better cave control and general ease of handling. In long blast hole stoping, where used to replace loading machine draw points, they lead to lower maintenance charges and less tie-up of costly equipment.

Major difficulties concern support of the horizontal openings in stressed ground beneath caving areas, together with wear on both drives and scraper installations. The support problem is being met in two quite different ways; firstly by the use of massive monolithic concrete and secondly with yieldable steel arches. Where concrete is used the tendency is to omit reinforcement, which proves unsatisfactory in regions subjected to heavy concussion from blasting. Under such conditions a homogeneous mass of good concrete gives better service. Scram drive floors are often lined with rails set in concrete, but there is growing belief that it is less costly to omit rails and merely repour a concrete floor as required.

Yielding steel arches are being used for support in slusher drives in place of timber or concrete lining. Installation costs are slightly higher but maintenance costs are reduced and recovery and re-use is possible.

Large, over-powered scraper hoists reduce maintenance costs and units up to 150 h.p. are in use. Scrapers fitted with folding type blades are common. A 45 deg. concrete ramp below the tail sheave reduces build up of material behind the scraper. Remote, push-button control of some of the larger installations is reported.

At the Mountain Con mine, incorporation of scram drives to replace lengthy gravity passes in block caving areas has resulted in better draw control and raised production. Grizzly drives are still used above the scrams. Scrapers deliver direct to mine cars, so eliminating loading chutes. All grizzly and scram drives are concreted, the concrete being placed by "Pumpcrete" machines or pneumatic placers. Supplies of ready mixed concrete are received through pipelines from the surface where mixing is done in a central plant.

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Placing is at the rate of 22 to 30 cu. yds. in 4 hours. Rock bolts are used for temporary support where conditions permit.

In Northern Rhodesia there is a growing trend away from scram drives back to gravity transfer systems. This is believed to be due to increasing support difficulties with depth, and to high maintenance charges on equipment.

According to a report from Sherrit Gordon Mines Ltd., scram drives have proved troublesome and expensive, largely on account of wear difficulties, and would in all probability never be used at a new location.

In the Quebec Asbestos Mines, however, scram drives are increasing at the expense of gravity transport in finger raises. Scraping reduces development work, and increases rate of production; but at the same time effective use of scram drives can only be made when the whole operation is planned for handling large size material to an underground crusher station.

Supports

Increasing application of continuous coal mining has brought attendant problems, not the least of which is the overwhelming need for good roof control both at the face and in the access roads. Roof bolts and yielding supports are being used on an ever increasing scale and the trend in recent years towards the adoption of yielding props on the face is contributing to a systematic continuity of face advance. Mechanical yielding props are favoured on the Continent, although more attention is being paid in Germany to the design of hydraulic props. Much work has been done in developing self-advancing mechanism; i.e., compound systems of yielding supports which can be moved forward as a complete unit. The use of such supports gives many advantages: the roof is continuously supported, high support density and load bearing capacity, withdrawal and advancing of supports are safely expedited. A British self-advancing system has been designed by Campbell Ritchie and consists of two telescopic floor frames, each carrying four vertical yielding props which serve to hold the horizontal roof bars. In the normal working position the two floor frames are telescoped and thus in effect the unit consists of a steel raft bearing eight props and four bars.

To advance the unit the outside four vertical props are telescoped and the integral ram is operated, causing the outer floor frame to be pushed forward; the inner frame still being under roof load acts as the stay. On completion of the forward stroke of the piston (the length of which depends on the advance required) the outer vertical props are tightened to the roof. This position is illustrated in the diagram. (Fig. 6.) Next the inner four props are released and the inner floor frame is telescoped into the outer one as the cylinder ram is retracted. Finally the inner four props are tightened up. The moving device comprises a compressed air or hydraulically operated double acting pushing cylinder, the body of which is attached to the outer floor frame. Normally an interval is considered desirable between the advance of the outer frame and the retraction of the inner frame, since this allows the props on the outer frame, to take up the roof load before the props on the inner frame are rendered inoperative. The forward motion of the ram can also be utilized to push forward the face conveyor, this being very useful where articulated face conveyors are being operated.

On the Continent there are several types of movable support systems, most of which incorporate hydraulic vertical props. The type having probably the widest application is the Seaman hydraulic chock system. Each unit consists of a square chock built up of four vertical props mounted in a steel framework. The four props are interconnected hydraulically, one prop carrying the valve gear for all four. Mounted on the base of the chock structure is a horizontal hydraulic ram used for advancing the chock. The fluid used for operation of the props is a mixture of water and soluble oil and the power is supplied by a motor driven pump in the gate road through a $\frac{1}{2}$ in. reinforced hose pipe. The total setting load on each chock is 24 tons and the yield loan is 120 tons. Figures obtained recently during time studies have shown that the Seaman advancing chock can be moved forward and re-set in under one minute, this comparing with over four minutes required to move forward and re-erect a normal steel chock with mechanical release.

As an alternative to composite chocks such as described, Dowty Mining Equipment Ltd. are manufacturing hydraulic self-contained 80 ton (yield load) chocks, some of which have been fitted with hydraulic advancing rams. A setting load of 20 tons is possible with these chocks, although normal setting load is 10 tons. These single chocks have the advantage that they are more compact than composite chocks and having fewer external elements they are probably less susceptible to damage. They are, however, expensive.

Rock Bolting

Rock bolting has become an accepted method of support for the walls of shafts and the walls and backs of stopes and roadways. It is used to an increasing extent to compact the peripheries of tunnels through incompetent rock and it finds an application in rock which is inherently self-supporting to reinforce against pressure bursts.

In tunneling operations through unstable ground, rock bolting is replacing both steel arch and timber support.

Length of bolt should be at least equal to the depth of round, and bolts should be placed as soon after blasting as possible. Bolt spacing is calculated from the load which can be safely placed upon each bolt, together with the "dead weight" of the rock volume to be supported. The safe working load is taken as 50 per cent of the load at which the anchor yields or the bolt begins to stretch.

Effective anchorage is a function of the type of rock. In a sound, medium-hard rock the anchor will withstand a greater load than the bolt and the bolts may be stressed initially to 50 per cent of their tensile strength. Where the rock is either soft or very hard, however, anchoring is a

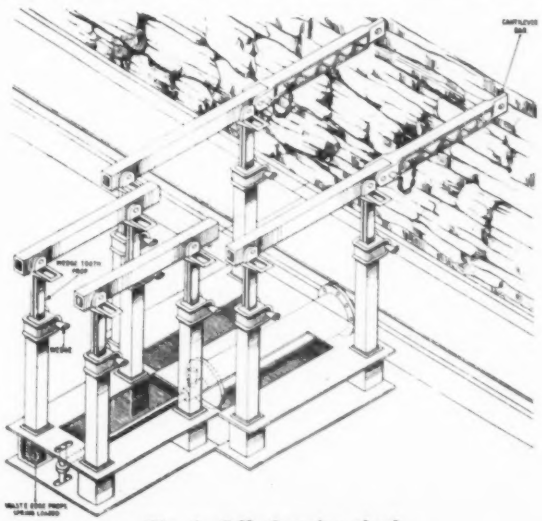

Fig. 6. Self-advancing chock

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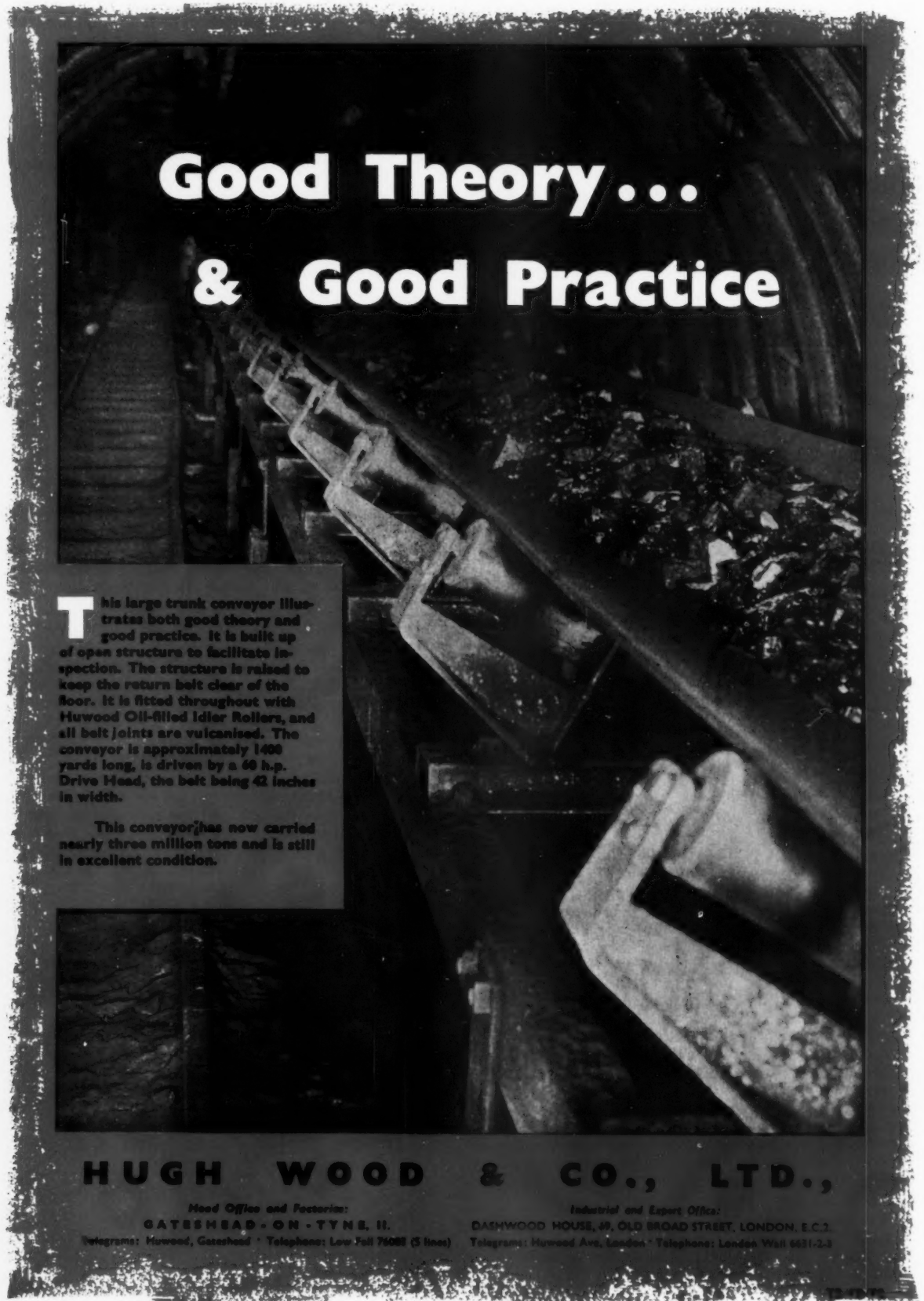
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This large trunk conveyor illustrates both good theory and good practice. It is built up of open structure to facilitate inspection. The structure is raised to keep the return belt clear of the floor. It is fitted throughout with Huwood Oil-filled Idler Rollers, and all belt joints are vulcanised. The conveyor is approximately 1400 yards long, is driven by a 60 h.p. Drive Head, the belt being 42 inches in width.
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problem, and conventional bolts may be stressed only to a fraction of their tensile strength. In such cases either smaller diameter bolts with increased anchoring surface should be employed or the bolts grouted into place. Reinforced concrete anchors have been used with notable success in ground which flows or "heaves".

In dry, chemically stable rock, bolting provides durable support but is not alone sufficient in badly decomposed ground or where corrosive water is present. Under such conditions, however, rock bolting still shows important savings in cost and speed of the complete operation when used for temporary support only, to be followed at a later time by timber, steel, or concrete lining.

At the Anaconda Mountain Con. mine, extensive use of rock bolts has practically eliminated timbering with consequent reduction by one-third of the excavation formerly required for main openings in stoping areas.

Equally impressive are the savings effected through rock bolting in stoping operations. Reports of square setting being replaced by the cut and fill method with rock bolting are numerous. Elimination of timbering by roof bolting in cut and fill stoping facilitates scraping, and, in some cases, pinning of the walls in extraction by the shrinkage method has reduced dilution.

The Copper Range Co. have found that a rock bolted loading chute gives considerable savings in labour, materials and maintenance charges. Timber apron chutes for loading from shrinkage stopes are bolted to the walls of the haulage drives, thereby minimising the use of timber blocks and bracing, and giving more durable construction. A similar system was adopted at Kiruna where chutes of steel construction were used. The Britannia Mining and Smelting Co. have successfully rock bolted steel-work to their concrete control chutes, and use of rock bolts to reinforce ground at boxholes before cutting out has reduced overbreak.

At an American coal mine the problem of maintaining a trunk belt conveyor above a heaving floor was successfully overcome by suspending all equipment from roof bolts.

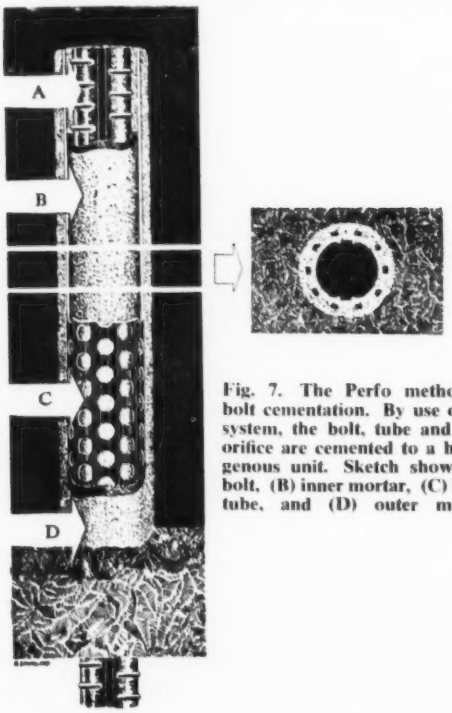

Fig. 7. The Perfo method of bolt cementation. By use of the system, the bolt, tube and rock orifice are cemented to a homogenous unit. Sketch shows (A) bolt, (B) inner mortar, (C) Perfo tube, and (D) outer mortar.

The importance of pre-loading rock bolts to a calculated stress soon after installation is well known. The torque meter in common use for control measurements can, however, give erroneous readings if bolt threads are rusted or clogged, so that for results to be consistently good all threads should be uniformly machined, clean and oiled. In order to overcome this difficulty, methods have been devised for obtaining a direct indication of the load placed upon the bolt. One such method depends upon compression of a heavy spring washer and another method measures the increase in circumference of a rubber compression pad.

The Perfo method of rock bolting, first introduced in Sweden in 1954, enjoys increasing popularity. (Fig. 7.) It provides a relatively simple means of obtaining a result equivalent to that given by a grouted bolt. The method consists briefly of inserting into a bored hole a perforated cylindrical metal tube which has previously been filled with cement mortar, and then driving into the tube a plain or ridged bolt. This forces part of the mortar through the perforations in the tube and into intimate contact with the sides of the bore hole. Addition of a quick-setting agent to the mortar enables pre-stressing to be carried out about one hour after placing. One man can place up to 35 Perfo bolts per shift.

At Kiruna, where the Perfo method has been used in the reinforcement of the walls of several new shafts and drifts, it has been found to be cheap and simple.

Choice of conventional bolt is between the slotted type and the expansion shell type. Installation of the slotted type requires the extra step of driving to anchorage with a percussive tool, thereby increasing installation time over the expansion shell type by approximately 20 per cent and necessitating a supply of compressed air. Overall cost of material in the slotted type is usually greater, and this type gives less efficient anchorage in semi-plastic rocks. The trend is towards $\frac{5}{8}$ in. dia. expansion shell bolts made from higher grade steel.

Power Stowing

The need to solid stow coal faces is, of course, much greater in heavily industrialized areas where limited high quality coal resources necessitate complete extraction, and so the problem of solid stowing receives much more attention in Europe than, for example, in North America. Whatever method of power stowing is practised the process is a costly one and the trend of new developments is to reduce power and depreciation costs. Mechanical type slinging stowers appear to be losing popularity and most new power stowing installations are utilising pneumatic stowing or scraper stowing as a means of filling the waste. In Germany almost 25 per cent of the goaf is stowed pneumatically, the corresponding figure for the U.K. being some five per cent.

Both the pneumatic and the scraper systems of stowing allow greater latitude than the mechanical stower in enabling coal filling to proceed simultaneously with packing. With regard to pneumatic stowing there are two schools of thought—one being that the stower should be as close as possible to an individual face and the other being that central stowers should be maintained remote from the face but capable of serving several units. From the point of view of haulage requirements there is much to be said for a central stowing plant. Consider, for example, a longwall face 150 yds. long and 6 ft. high with a daily advance of 4 ft. 6 in.; such a face would require approximately 700 tons of dirt per day to solid stow. The transport of this quantity of dirt to a stower sited near the face places a heavy burden on the haulage system serving that face. On the other hand a central stowing machine remote from the

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face has the distinct disadvantages of higher air power costs and increased pipe wear.

One of the drawbacks of pneumatic stowing of any description is the high cost of compressed air and this is more pronounced in collieries where electricity is the main source of power; necessitating special compressed air plant for the stower. Bearing in mind that the air consumption may be as high as 120 cu. yd. of free air per cu. yd. of pack, the power cost alone may well be of the order of sixpence per ton of coal extracted. The total cost of pneumatic stowing obviously varies widely with the conditions obtaining and the size of the installation. Recent figures show that the final cost may exceed 16s. per ton of coal mined, although an average value is of the order of 5s. per ton.

New Low-Pressure Pneumatic Stowers

An interesting low-pressure face-sited stower has been developed in Britain by the National Coal Board designed to operate at the relatively low pressure of 20 p.s.i. (Fig. 8.) Intended to be operated on the face itself in line with the track to be stowed, the stowing machine is electrically driven and is only 2 ft. 9in. high. By being placed on the face this stower elminates roadway pipes and the bend into the face, thus reducing both the quantity and pressure of the compressed air required. This reduced demand enables a small inbye compressor to be used to supply the air thereby eliminating the unavoidable leakage losses inherent in the normal pneumatic stowing plant which receives its air supply from a remote compressor. This inbye compressor is an air cooled electrically driven three stage turbo-blower which is able to generate 2,000 c.f.m. at 20 p.s.i. It is interesting that the machine is only 13 ft. long by 5 ft. high by 3 ft. 6 in. wide and special anti-surge gear is incorporated, ensuring that the compressor automatically adjusts its performance to suit the needs of the stowing machine.

On the Continent a similar type machine which is receiving favourable attention is the Brieden KZS 50, designed to handle 52-65 cu. yds. of stowing at 11.75 p.s.i. The design follows standard continental practice in that the machine itself is driven by a 15 h.p. compressed air motor, but as compressed air is the standard source of power in many continental collieries the use of a compressed air motor is a practical proposition. The average air consumption of the Brieden stower is stated to be 1,600 cu. ft./min., this corresponding to an air consumption/stowage capacity ratio of about 60: 1—considerably lower than that of many other machines. The maximum length of pipe range recommended is 100 yds. without bends.

Much work is being done towards reducing the high wear on pipe lines. This contributes largely to the cost of pneumatic stowing. According to Rauen (Germany), who investigated many installations, normal steel pipes of moderate hardness have a life of 13—39,000 cu. yds. of material stowed, laminated two layer pipes have a life of approximately three times this figure, and pipes lined with fused basalt last 20 times as long as normal steel pipes. Much depends, of course, on the manner in which the pipes are laid. Despite the high cost of basalt lining the use of such pipes is often practicable, especially at bends where rate of wear is some 70 times higher than in a straight length of pipe. Chrome steel pipes and armoured rubber hose have been tried with varying success.

Fig. 9. Blagdon-Durham portable mine pump

Drainage at the Face

Frequently the quantity of water made at the coal face is rather too large to be economically dealt with by a hand operated pump and yet does not call for a power driven mechanical pump. These latter require a separate power feed and consequently have limited mobility. A new design, the Blagdon-Durham pump, has recently been installed in several British collieries and possesses a distinct advantage in that it can be operated at any part of the face where a rotary drill is being used. In operation the chuck of the drilling machine —pneumatic or electric—is slotted on to an extension on the pump driving shaft and so the rotation of the drill driving shaft is transmitted to the small portable centrifugal pump. (See Fig. 9.) The pump can be operated by drills having rotational speeds of 200-800 r.p.m.; with a typical drill speed of 600 r.p.m. it can handle 80 g.p.m. against a 50 ft. head.

The pump has an effective overall height of 10 in., a base diameter of 8 in. and weighs only 40 lb. It can operate in a depth of water of as little as 1¼ in. The Blagdon-Durham pump comprises three main sections. These were formerly of cast steel, but this is to be superseded by spheroidal graphite cast iron to counter the effects of corrosion and general deterioration inevitable in mine workings.

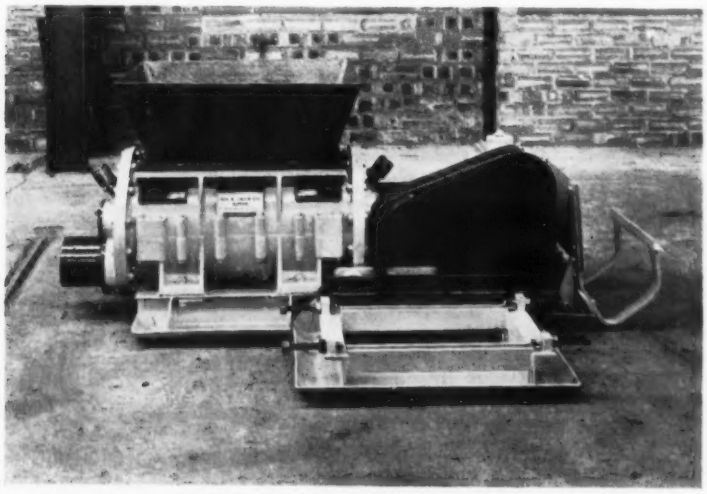
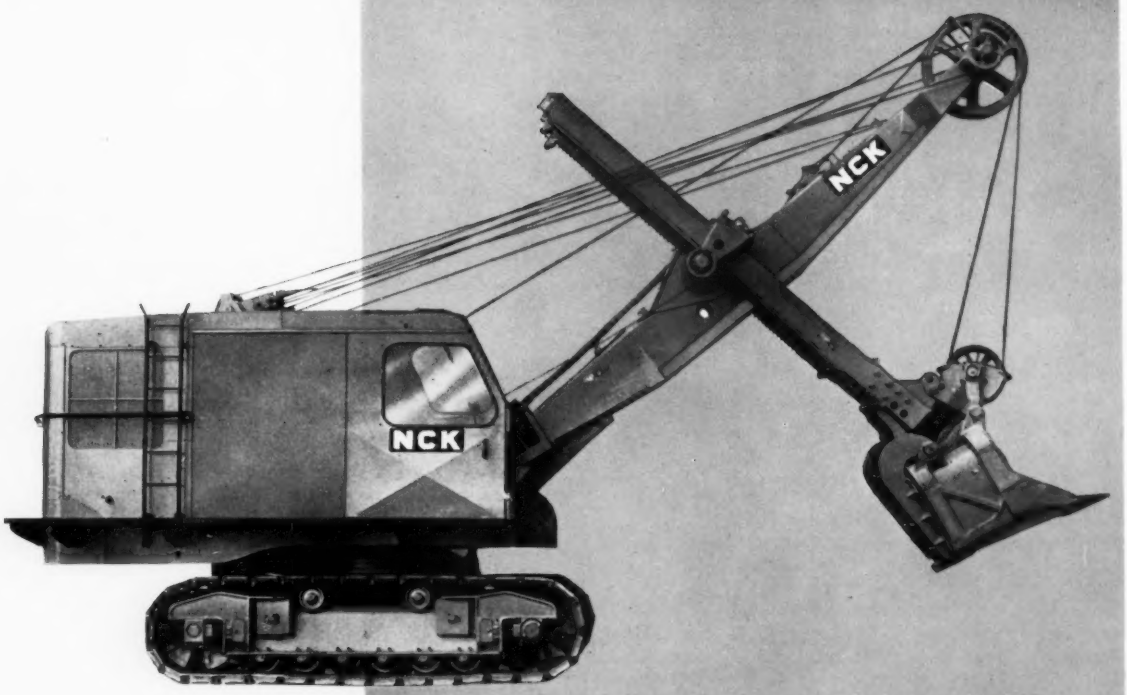


Fig. 8. N.C.B. low pressure pneumatic stowing machine.
By courtesy of Keir & Cawder Ltd.

NCK



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The upper gear case section carries the main drive shaft threaded at one end to receive a universal fitting for coupling to mining drills and flanged at the other to form a planet wheel carrier. This shaft is supported in bearings, spaced by a tube, and positioned by a circlip in a groove in the wall of the gearcase. A recess in the base of this casing accommodates a flanged internally toothed annular gear, which is drilled to allow it and the gear box bottom cover plate to be secured by studs to the casing. The cover plate houses a bearing, sealed on its lower side, which supports the pump impeller shaft; shaft and sun wheel pinion forming an integral unit. Spring loaded shaft seals retain the special pre-packed lubricant and exclude water etc., promoting the "operation-without-maintenance" feature so necessary with equipment of this nature.

The centre section is cast eccentrically and forms the impeller casing, the outlet delivery from which takes the form of a faced flange to which any pipe or hose connector may be bolted as required. The fully balanced bronze impeller carries a spring loaded carbon seal and rubber gland unit, the former seating against a circular projection on the base plate of the gear casing.

A cast steel strum to exclude extraneous matter bolts to the centre section. The bolt head shrouds function as feet to assist stability. Slots in the base enable water to be removed to a minimum depth of 1¼ in. on a hard surface. On a loose surface minimum operating depth is approximately 5 in. Advantages claimed for the pump are :

1. It does not require any special supply of its own;
2. Slurry and water containing solid matter can be effectively handled;
3. It can operate on the snore.

The pump has operated satisfactorily in several British mines and it seems likely that its use will become more widespread.

Mine Safety

Possibly nowhere in the mining world has more attention been paid to safety than in the nickel industry of the Sudbury Basin, Canada. In a recent survey of safety practices, A. E. O'Brien records that over the past 25 years the number of accidents per 1,000 shifts worked in INCO mines and treatment plants has dropped from 0.14 to 0.028 and the severity from 10.87 days lost per 1,000 shifts to 1.73. Over the five-year period 1950-55 the number of INCO employees fatally injured in non-industrial accidents was twice that of those injured on the job. Moreover, most of the injuries received both in the job and off are now due to carelessness rather than to unsafe equipment or procedures, which indicates the present high standard of safety and lays stress on the importance of safety education.

Fig. 10. Foam plug advancing along roadway.
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Most recent and positive instruction practice is "personal contact" instruction. This is given regularly by each shift boss to all the men under his supervision taken separately. It augments other "on the job" instruction and enables an individual record to be kept of each man's safety education.

Other activities of the Safety Dept. cover the compiling of standard practice boks, the making of coloured posters, design of protective equipment and clothing, investigation of accidents and inspection of equipment on which the safety of men depends.

Safety bonus payable to shift bosses and foremen has been discontinued in favour of an award made to all men who worked in a mine throughout a 100,000 safe-shift period. This award now takes the form of two free cinema tickets which, unlike safety badges, retain their appeal.

The fire hazard underground is an ever-present danger in mining, especially where coal is the mineral being worked, and for some time the British Safety in Mines Establishment have devoted attention to the possibilities of quelling underground roadway fires by the use of foam plugs. The fighting of fire in an underground roadway does, of course, present far more difficulties than surface conflagrations. Limited space, insecure roof, disrupted ventilation and backing of smoke all contribute towards the difficulties of bringing the fire under control by on-the-spot conventional manual methods of fire fighting.

The foam plug technique is designed to enable a fire to be brought under control by remedial measures carried out at a point remote from the seat of the fire. Essentially the method depends on the production of a large volume of air-water foam completely filling the roadway, this plug then being pushed by the normal ventilating current into the fire zone. To generate the vast quantities of foam necessary (tens of thousands of cubic feet per minute), a net made of textile material having ½ in. holes, is stretched across the roadway on the upwind side of the fire. The upwind side of this net is sprayed with water to which wetting and foam stabilising agents have been added and the action of the air in passing through the saturated net creates foam bubbles on the down wind side. These bubbles coalesce into a honeycomb of foam which completely fills the roadway section and the foam plug is then carried by the air stream on to the fire (Fig. 10.)

The water content of the foam is about one tenth of one per cent by volume and men can breathe freely if caught within the plug. On passing into the fire zone the vapourization of the water in the foam will reduce the oxygen content by some 50 per cent and so blanket the fire. In addition, the foam would have a cooling action and this factor, combined with the oxygen excluding and diluting action of the foam plug, suggests that here is a promising method of tackling extensive roadway fires underground.

At present, however, the method is only in the experimental stage and further trials are going on to determine the best method of generating and propagating the foam. In the S.M.R.E. test gallery at Buxton plugs have been generated and propagated for distances of over 200 yards. The stability of the foam in a dry and dusty mine has yet to be found and also the effect of a foam plug on the general ventilation circuit of a mine has yet to be assessed. Until full scale pit trials have been carried out, it is not known how long the foam would take to cool a mine roadway

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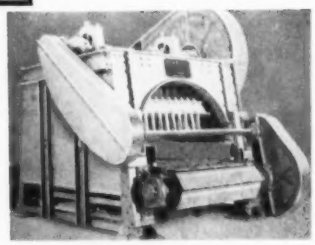

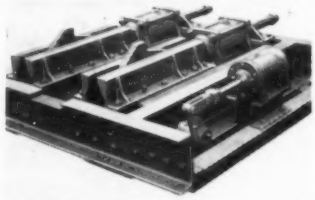

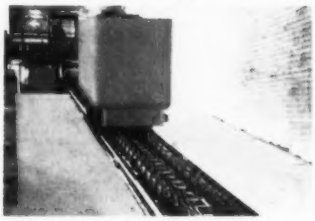

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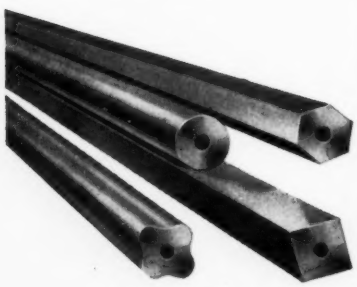

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after the fire had passed the flaming stage, and it may be necessary to complete the full extinction process by normal methods at the seat of the fire. However, even if this were necessary, the initial use of the foam plug technique may well have saved the costly alternative of sealing off the district.

Haulage

Coincident with the development of high capacity loading machines, the need has arisen for a better link between the loader and the main haulage system. Existing equipment is not always capable of coping with the productivity of these big new power loading machines, and if loading continuity is to be maintained a possible solution is to use the recently developed extensible belt conveyor (Fig. 11.) This has been developed by the Joy Manufacturing Co. and provides continuous long distance transportation behind the miner together with the necessary easy extension. The conveyor consists of tractor mounted head-end and tail-end units connected by a wide rubber belt supported on specially designed idler sets. Incorporated in the conveyor run is a multiple loop take-up, automatically tensioned and having a storage capacity of 100 ft. of belt.

In operation the tail-end unit is positioned under the discharge boom of the continuous miner, and whenever the miner is advanced for a new cut the conveyor tail section is moved forward by operating the crawler control valves on the tail section. The extra belt required is supplied by the loop take-up in the conveyor run and is automatically kept at the correct running tension. During an advance the carrying idlers are set up as needed at five foot intervals whilst the conveyor is running: conversely in retreat the idlers are removed as required.

The drive or outbye section of the conveyor incorporates a standard 24 in. belt tandem drive and uses a triple-section hydraulic pump to power the crawlers and to effect tensioning. The tail section unit has a two section pump, which is used when the tail end is moved up to follow the continuous miner. Each crawler is self contained having its own hydraulic motor, gears and chain drive. All parts are interchangeable.

One very important part of the extensible conveyor is the suspension type idler set which is used. This is termed the Joy Limberoller and consists of a specially designed steel cable on to which has been moulded a series of Neopreme discs. The cable has two terminal bearings which are carried by lightweight tubular idler stands. The Limberoller is flexible and the special design enables idler sets to be added or removed whilst the conveyor is running. The idler sets are light and weigh only about one-third as much as a set of conventional steel idlers. After the continuous miner and the belt have advanced 50 ft. an indicator light on the tail unit goes out, giving a visual warning that the conveyor is fully extended. A 100 ft. length of conveyor belt is then added, the take-up run back, and loading recommences.

The Joy XB 36 in. wide belt can handle a peak load of 440 tons/hr. (continuous rating 300 tons/hr.) and has a maximum length of 330 yds. Even more loading flexibility is achieved by the use of a small bridge conveyor between the miner and the extensible belt, enabling the loader to drive cross cuts. The bridge conveyor is flexibly supported from the boom of the miner and the tail unit of the extensible belt. This mobile high capacity combination provides an ideal link between loader and main haulage.

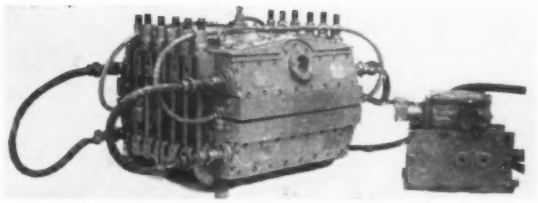


Fig. 12. Greengate and Irwell vulcanizer used in the vulcanizing of PVC belts

Vulcanizing P.V.C. Belts

Although rubber belts have been vulcanized underground for many years, it was not until last year that suitable F.L.P. equipment became available for the vulcanizing of P.V.C. belts (Fig. 12). Essentially the difference between vulcanizing P.V.C. belts and similarly joining lengths of rubber belt is that the former process requires a higher temperature (320 deg. F. as compared to 287 deg. F.); furthermore, P.V.C. joints must be cooled under pressure to 210 deg. F.

To expedite the cooling under pressure the platens in the P.V.C. vulcanizer are fitted with internal tubes through which compressed air can be blown. The heating elements in the platens are of the tubular type giving uniform distribution of some 20 kW. There are coolers attached to each end of the platens to prevent flow of heat away from the joint since, if this took place, the consequent softening of the P.V.C. would result in ply separation.

The vulcanizer weighs 2¼ tons but can, of course, be split into two halves to facilitate carriage to the site. Dimensions are 3 ft. 11 in. x 4 ft. 4 in. x 3 ft. 4 in. high and the equipment is capable of taking a belt up to 36 in. wide and vulcanizing a length of 36 in. at each application. The bigger the belt to be joined, the greater is the longitudinal length of the joint and hence more applications of the vulcanizer will be necessary. A typical time cycle for joining lengths of 30 in. x 6 ply belting (requiring two applications) shows that approximately 7¼ hr. are required for the entire operation, including preparing the ends for joining. Wider belts requiring three charges take about 9½ hr.

As with normal vulcanizing, great care is required when preparing the ends for joining. Ends are treated with a special P.V.C. paste rubbed in with a very stiff brush and a thin sheet of P.V.C. is interposed carefully between the stepped ends before these are clamped together and placed in the vulcanizer.

After running for almost a year, ten joints made in 30 in. wide x 6 ply P.V.C. belting on a trunk conveyor approximately 1,000 yd. long show no signs of deterioration and give every promise of complete satisfaction.

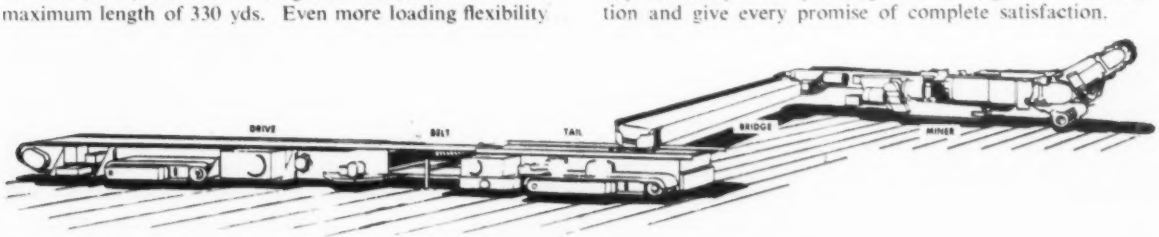
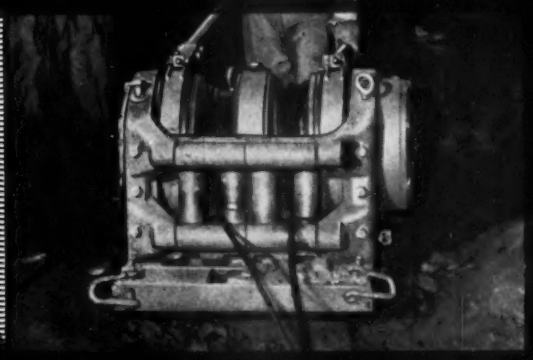


Fig. 11. Joy extensible belt conveyor

For the long strong pull.....



. . . nothing is more completely trustworthy than the British made PIKROSE SLUSHER. This is the 30 h.p. double drum Electric Size 2A at work in a Sudbury nickel mine. It is compact, adaptable to narrow slopes, easy to set and anchor, easy to work, exceptionally low in maintenance cost — a tough, dependable machine for tough work.

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Apart from the obvious working advantages of vulcanized joints, the elimination of metal fasteners on high resistivity P.V.C. belts is very desirable from the safety aspect. From observation, it appears that some P.V.C. belts are more prone to electrostatic sparking than are rubber belts. Such sparking may occur when a metal fastener approaches a troughed idler and although this is not a common occurrence it is an undesirable phenomenon that should be eliminated. An immediate protective measure is to keep the P.V.C. belt damp and hence electrically conducting, but this may give rise to belt slip in the conveyor drive unit. Work is proceeding on the development of a suitable anti-static P.V.C. belt, either by incorporating carbon black in the covers or by the use of chemical agents in the P.V.C. to increase conductivity. Many existing P.V.C. belts are of satisfactory low resistance as a result of using low resistivity grades of polymer.

Hydraulic Transport

What is believed to be the first hydraulic transportation system of its kind in the world came into operation at Woodend Colliery, Scotland, during the year. This marked another step forward in the experimental work currently being done on the possibilities of pipeline transmission of coal. Woodend was selected for the experiment for three reasons. (1) The shaft is only 250 ft. deep; (2) Large quantities of water had to be pumped to the surface in any case; (3) The output consists of anthracite which can be broken underground without losing value.

The plant consists of a main circulatory water pump of 750 g.p.m. capacity, which operates from the main sump and delivers water to the surface through a 7 in. pipe range via the coal feed hopper. (Fig. 13.) The latter receives minus 2 in. coal and has two exit valves through which the coal is removed by means of a large crank driven reciprocating feeder. This is 9 in. dia. and is bored diametrically with two 7 in. dia. holes so positioned that as the piston reciprocates these holes—or buckets as they are termed—are alternately under a hopper exit valve and then in line with the main delivery pipe. In this position the coal in the buckets is flushed into the coal transport pipe. By this arrangement one bucket is receiving coal from the hopper simultaneously with the discharge of coal from the other bucket into the pipeline.

To expedite the flow of coal through the hopper exits and into the buckets, a 30 h.p. 500 g.p.m. suction pump is utilized. The reciprocating plunger is crank operated by a 10 h.p. motor, crank speed being 90 r.p.m. Thus 180 buckets of coal per minute are delivered to the pipeline—equivalent to a throughput of 60 tons/hr.

On the surface the 7 in. pipe delivers on to a vibro-screen fitted to the top of the receiving tank. Although now operating on an open circuit, it is intended eventually to convert to a closed circuit. It is estimated that the tests to be done to establish the scope and efficiency of the system at Woodend Colliery will extend over a period of two years. Provisional estimates suggest that the cost of raising coal by this means will compare favourably with normal winding practice, but there are many factors yet to be determined.

Work is proceeding elsewhere in Europe on the development of hydraulic transport of coal, both vertically—which is the simplest case—and also horizontally. It is horizontal transmission which offers the widest field for pipeline transport and in the U.S. work is well advanced on a surface pipeline to carry 8,000 tons per day a distance of 115 miles. This suggests that from an economic standpoint hydraulic pipeline transmission compares well with large scale surface haulage.

Hoisting

The swing towards multi-rope friction winders is gaining impetus in both the metal and coal mining industries. Whilst Germany and Sweden undoubtedly pioneered this system of hoisting, it is only within the last few years that mining engineers elsewhere have fully realized the benefits of multi-rope hoisting. In both Sweden and Germany it is universal practice to employ stranded ropes on friction hoists—whether multi or single rope systems—but in Britain locked coil ropes are considered to be superior for this duty. Advantages of the locked coil rope are its great strength and non-spin characteristic and an important feature is the large surface area presented to the tread on the friction sheave, thus contributing towards reduced wear of the treads. Since the satisfactory running of multi-rope hoists is closely associated with the grooves on the winder drum being maintained at an equal diameter during service, British engineers have decided to adopt locked coil ropes and these will be used at the several installations now projected.

Opinions continue to be divided regarding tower construction on the steel versus concrete issue. Generally it is conceded that provided there is little likelihood of ground movement, concrete towers are cheaper to build and maintain but there is a strong school of thought favouring steel constructed towers in all cases. The reasons underlying this contention are that steel is not so sensitive to normal vibratory movement of machinery as reinforced concrete. In addition, operational charges and modification to the steelwork design are easier to effect.

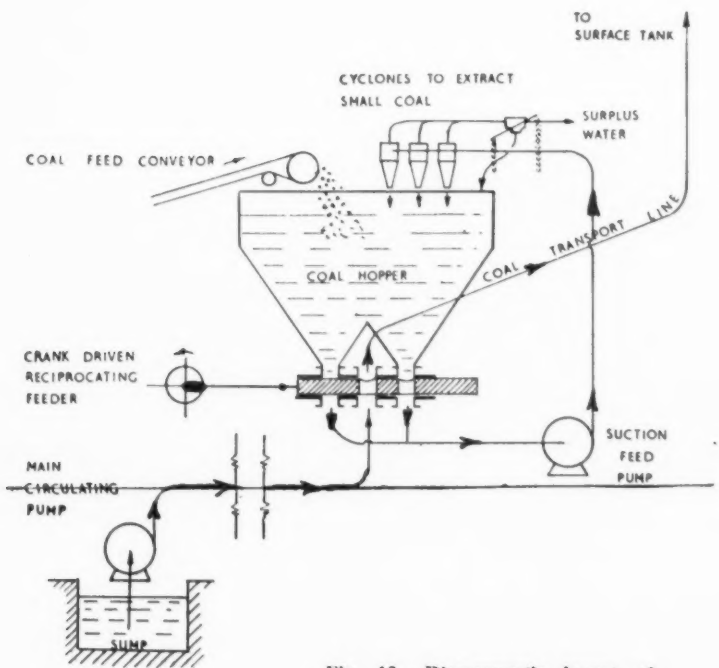
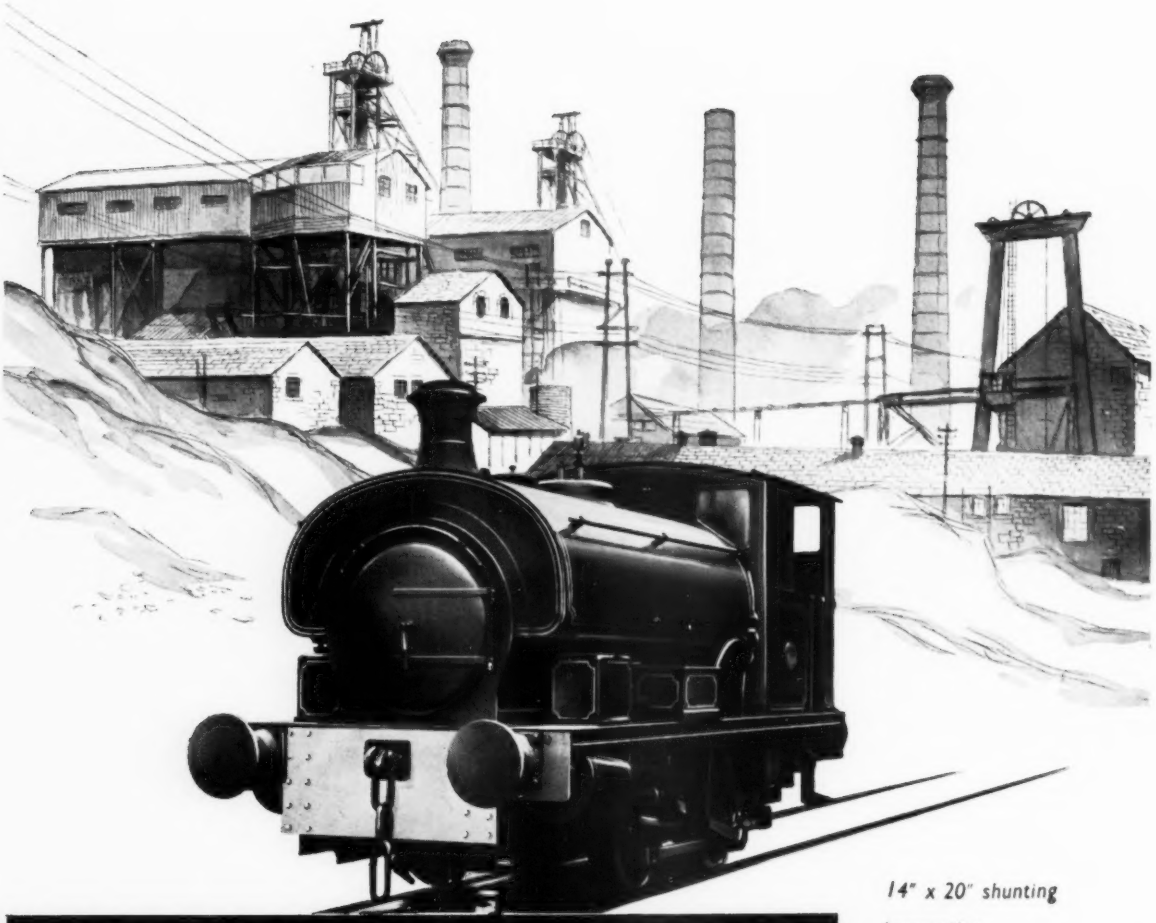


Fig. 13. Diagrammatic layout of hydraulic hoisting plant.



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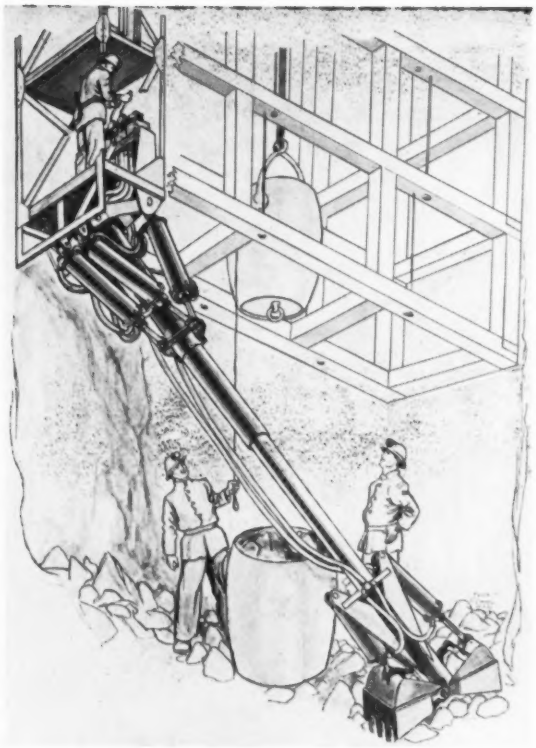


Fig. 14. Cryderman shaft mucker.

As an indication of the extent to which multi-rope hoisting is being adopted, the following new installations are representative :

	U.K. Coal mine	*U.S.A. Metal mine*	*Canada Metal mine*	*Sweden Metal mine*
Winding depth	2,648 ft.	3,940 ft.	4,200 ft.	1,500 ft.
No. of levels ...	2	2	2	3
Max. speed ...	40 f.p.s.	35 f.p.s.	37 f.p.s.	37 f.p.s.
No. of ropes ...	4	4	4	4
Pay load ...	20 t.	13.5	8 t.	20 t.
Motor H.P. ...	2 @ 1350	1500	1500	1150

In North America eight installations are projected and in South Africa a four-rope tower friction winder is to be used by West Driefontein Gold Mining Co. Ltd. in a 5,460 ft. shaft. This winder is designed for a skip load of 14 s.tons and will be one of the largest in existence, the drum being driven by two 2,000 h.p. motors. These and similar installations indicate the worldwide attention now being paid to sheave hoisting.

Shaft Sinking

Within the past 12 months, reports of ever increasing achievements in high speed shaft sinking have come from South Africa, the finest performance recorded so far being an advance of 763 ft. in 30 days. This was from West Rand Consolidated Mines and the shaft was manually cleaned.

The No. 1 Ventilation Shaft at Vaal Reefs was deepened 3,017 ft. to a depth of 3,768 ft. in a period of no more than five months, which represents one of the highest averages ever reported. The shaft here is an 18 ft. dia. circular and was fully concrete lined under cementation cover. Cleaning was again by hand, the rate averaging one ton per minute. One double-drum hoist was used with 2½ ton kibbles.

These record-breaking achievements are attributable in part to technical improvements. Concreting proceeds simultaneously with sinking, and concrete is now delivered from surface by pouring through a 6 in. pipe. This enables cleaning and concreting to be carried on at the same time and achieves even greater independence between the various operations in the shaft bottom.

Although South African shaft sinking practice is based largely upon an abundant supply of relatively cheap labour mechanical cleaning is not overlooked and has been practised for some years. It is, however, in countries where labour is at a premium and many times more expensive when assessed in terms of hourly rates, that mechanical cleaning is making bigger strides. Best labour performance is reported from Giant Yellowknife, Canada, at 1.78 man-shifts per ft. of 18 ft. by 12 ft. timbered shaft. A Cryderman shaft mucker was used for cleaning. (Fig. 14.) This new machine can be built for use in either inclined or vertical shafts and is a logical development in the application of the power-operated clamshell. Its mode of operation will be readily deduced from the illustration. Compared to other mechanical shaft muckers the Cryderman is unique in its ability to operate in other than vertical shafts. Its potential capacity is rather higher and it requires fewer operators.

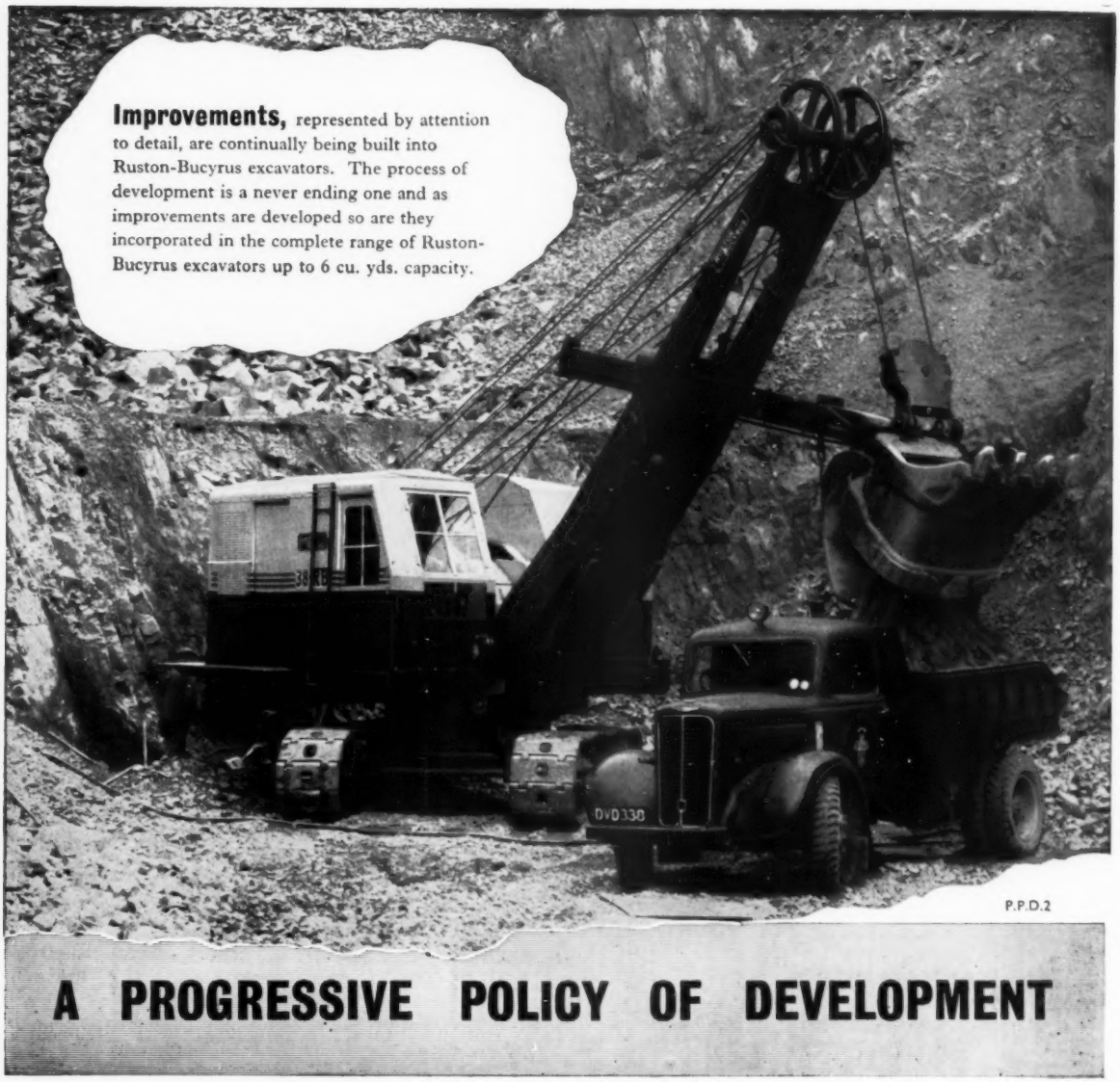
Use of heavier, jumbo-mounted machines in shaft sinking, as elsewhere, decreases overall drilling time and reduces manpower requirements. A six-boom rig of the type illustrated (in Fig. 15) is at present working in 19 ft. dia. shafts at the Homestead Mining Company's lead mines in South Dakota.

Time studies have shown that in shaft cleaning, the changing of buckets causes loss of loading time which can be appreciably reduced only by increasing the size of bucket. According to C. S. Boland, an optimum bucket capacity can be found to fit most sets of operating conditions. In one case cited, increasing the bucket size from 30 to 40 cu. ft. would result in an estimated increase in cleaning performance of 45 per cent, whilst above 70 cu. ft. capacity the increase in performance for each further 10 cu. ft. increment of bucket size would be less than two per cent, with an optimum size around 60 cu. ft.

The trend is towards more powerful sinking hoists of 3,000 to 4,000 h.p. and to larger buckets of 5¼ to 7 tons capacity.

In shaft sinking as in high speed drifting, and, indeed, in most mining operations, careful dovetailing of work is essential to efficiency. Work study and planned organization coupled to calculated monetary incentives is the formula for success.

Fig. 15. A shaft sinking Jumbo mounting six 3¼ in. machines



Improvements, represented by attention to detail, are continually being built into Ruston-Bucyrus excavators. The process of development is a never ending one and as improvements are developed so are they incorporated in the complete range of Ruston-Bucyrus excavators up to 6 cu. yds. capacity.

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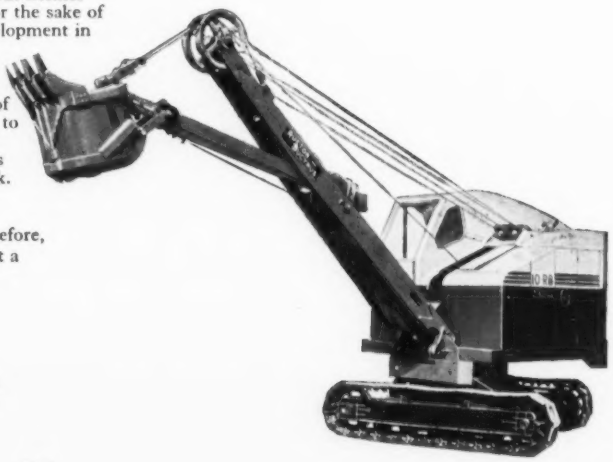

Replacement of your existing equipment can, therefore, be considered at any stage with complete confidence that a new R-B excavator will, in one direction or another, represent an improvement upon existing equipment.

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Open Pit Mining

By D. SUTTON, B.Sc., A.R.S.M., A.M.I.M.M.

A LARGE proportion of the world's supply of minerals continues to come from open pit operations. In the face of increasing depths of overburden and continued labour shortage the trend is towards bigger machines rather than underground methods. Closer scientific control of all operations is general.

Overburden Removal

Development in bulldozer, tractor-scraper, shovel and dragline equipment shows a tendency to use larger units with increasing attention being paid to the bucket wheel excavator in soft material.

Tractor horsepowers are up to 500, with rubber tyres replacing crawler tracks to an increasing extent. Rubber-tyred units are three to four times faster than their crawler-mounted counterparts and in all but the most exacting conditions show superior performance. At the Eagle Mountain Iron Mine, California, one rubber-tyred tractor does more clean-up work in a shorter time than was formerly accomplished by two crawler-mounted machines of equivalent horsepower.

Maintaining adequate traction on rubber-tyred tractors can be a problem where the going is loose, soft, or muddy, but for most purposes large diameter, low pressure tyres provide adequate flotation, and traction is improved by incorporation of 4-wheel drives with no-spin differentials. Where tractor weight is the limiting factor in determining maximum drawbar pull, hydro-inflation of tyres increases weight by several thousands of pounds, and incorporation of a hydraulic jack between tractor frame and trailer throws additional weight onto the tractor. Tubeless tyres are available in sizes up to 37.5×33, though savings in reduced maintenance charges, lost time and danger from blowouts effected through their use has yet to be assessed.

The self-loading, rubber-tyred tractor-scraper has gained acceptance as an efficient auxiliary machine in soft material up to depths of about 35 ft. Heaped capacities range from 8½ to 41 cu. yd. Loads are gathered in times around 2 min. and subsequent haulage is from 20 to 30 m.p.h.

In all high-speed diesel powered equipment incorporation of fluid drives (torque converters) and semi-automatic transmission systems is improving performance by eliminating stops for gear changing and increasing negotiable gradients.

Shovel size has reached a new high with a dipper capacity of 60 cu. yd. A few years ago shovels with a capacity of 2½ - 3 cu. yd. were most common, but these are now replaced by units having 5 to 10 cu. yd. bucket capacity with the really large units available for particular application.

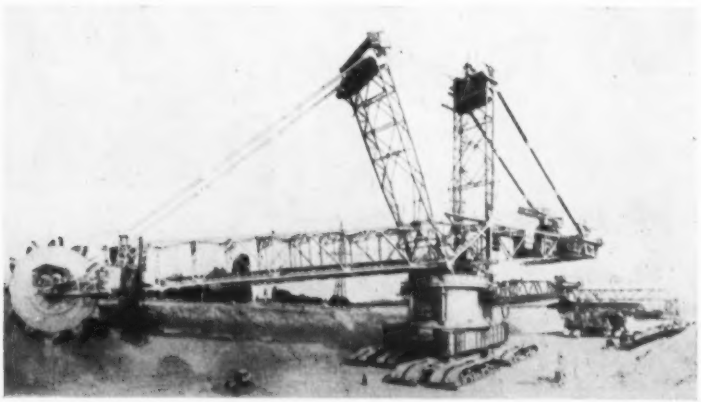
For long range digging and dumping of reasonably loose material the dragline is in common use.

A noticeable trend in both shovels and draglines is towards increasing capacity through the use of lightweight buckets made from alloy steel. Wear properties are satisfactory with improved resistance to extreme cold. In the Florida phosphate mines use of alloy buckets has raised dragline ratings by 15 per cent, while in one open pit coal mine a 35 cu. yd. dipper was replaced by one of 45 cu. yd. capacity.

In recent years much attention has been given to easing the task of the excavating machine operator, through work study coupled with application of advanced mechanical and electrical engineering principles. Stepless controllers requiring the minimum of physical exertion are incorporated in new machines, load indicators show when buckets are full or overloaded, and interlocks prevent accidental damage.

The bucket wheel excavator is coming more to the fore in the removal of soft overburden from flat-lying deposits. Its mode of operation makes possible high outputs at comparatively low cost. Uniform application of relatively small forces results in steady power consumption and the damaging effects of shock loads are avoided. Capacities range from 200 to 7,500 cu. yd. per hr. The largest units dig up to 163 ft. above and down to 20 ft. below the level of the ground on which they stand, and in some applications integral stacker conveyors increase dumping range beyond the reach yet possible with draglines.

At the Fiatt open pit mine of the Truax Traer Coal Company, the first large bucket-wheel excavator to be installed in America has replaced two 10 cu. yd. draglines. This machine digs a bench 50 ft. wide and removes overburden between heights of 29 and 75 ft. above the coal at the rate of approximately 1,500,000 cu. yd. per month. The remaining 29 ft. of overburden is removed with a 30-yd. shovel while a 7-yd. shovel excavates 4½ to 5 ft. of underlying coal.



General view of bucket wheel excavator.

Drilling

Churn drills are meeting with increasingly stiff opposition from rotary and large hole percussive units.

Rotary drills with tri-cone bits were adapted for open pit work in 1946, and recent incorporation of tungsten carbide inserts in this type of bit is extending use of the method into the harder rocks. Speeds of penetration were commonly two to three times those obtainable with churn drilling. Air flushing was first used in conjunction with rotary drilling in 1949 and is now adopted exclusively. Performance measured in cost per ft. drilled is 10 per cent to 25 per cent greater with air flushing on account of the higher speeds of penetration and increased bit life obtainable. Any open fissures or cracks from back break become

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filled with cuttings under pressure, giving better confinement of explosive. An additional advantage in cold climates is elimination of freezing water lines. Even in wet holes air-flush drilling is usually applicable with the dust collection unit disconnected.

In abrasive ground, however, the life of roller bits is often unsatisfactory, and in such conditions the percussive method of drilling gives better results.

A recent innovation which shows great promise is the "down-the-hole" percussive drill, in which the percussive unit is closely coupled to the bit and descends the hole at the end of a string of hollow rods. Compressed air is supplied to the drill through the rods and exhaust from the machine cleans the cuttings. Rotary motion is provided by a separate unit mounted outside the hole. This system overcomes the inefficiencies inherent in transmission of shock energy through a column of drill rods, and in consequence greatly increases rod life, enables high speeds of penetration to be achieved with large diameter bits, and reduces power requirements.

In a typical installation at a large open pit operation a three-man crew with a 10¼ in. rotary air-flush drilling unit drills 1,000 ft. of hole and blasts more than 30,000 cu. yd. of overburden in a shift. Typical performance figures for a 6 in. down-the-hole drill are as follows:

Rock	*Penetration Speed (ft./hr.)*	*Bit Life (ft.)*
Diorite	10 - 12	900 - 1,300
Granite	18 - 20	500 - 1,000
Hard Limestone ...	20 - 23	2,500 - 4,000
Medium Limestone	50 - 60	8,000 - 10,000

Rod life is approximately 7 × bit life.

At small open mines the trend is towards the multi-purpose unit, readily convertible from rotary to percussive drilling, operated by compressed air and mounted together with the compressor on a rubber-tyred truck.

Blasting

Use of millisecond delay blasting is increasing rapidly. Popularity of the short delay method is due to considerable improvements in fragmentation, reduction of overbreak and control of throw of broken material, as well as to reduction in ground vibration. Delay periods range from 8 to 100 milliseconds, and at a new location experiment is required to determine the delay most advantageous. Seldom does maximum fragmentation coincide with minimum vibration, so that the more important factor should be given preference where possible.

A simple formula which could well assist in eliminating expensive experiments at a new mine has been again suggested by O. Andersen, Inspector of Mines, Australia, who states that the relationship

$$B = \sqrt{dL}$$ where B = Burden in feet
d = Hole Diameter in inches
L = Hole Length in feet

holds good for all types of ground. Nature of the ground is taken care of by the strength and quantity of explosive in the hole. The formula takes no account of hole spacing, but as a first approximation this should be made equal to the burden.

A commercial grade of ammonium nitrate is finding favour as a low strength explosive in some American and Canadian open pit work. Mixed with six per cent of a high grade of carbon black the explosive is referred to as Akremite. This appears to be insensitive to ordinary detonators and is relatively safe until confined and initiated with a cap-sensitive primer charge. The ingredients are inexpensive and are transported separately at ordinary freightage

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rates. Akremite cannot be used in holes much smaller than 6 in. dia. and must be well confined with 8 to 20 ft. of suitable dry stemming. The explosive will not detonate if the moisture content exceeds 1½ per cent and in so far as waterproofing is concerned the practice of packing in plastic bags has proved an effective solution to this problem.

Regulations in some countries governing the manufacture of explosives together with special freight charges on substances used in their manufacture will undoubtedly limit wider adoption of Akremite and similar explosives.

In metalliferous ores, more attention is being paid to the large cost of transporting and crushing coarse material as opposed to the cost of finer size reduction in the blasting stage with reduced transport and crushing charges thereafter. There is some indication that at present price levels the trend towards use of large holes has been carried too far, and that smaller holes more closely spaced might well result in lower overall cost.

Convertible self-contained rotary-percussive drill.

Haulage

Conveyor belt haulage from open pit to treatment plant is increasing at the expense of truck haulage. Calculations made at the Will Scarlet mine are typical. Here a choice of haulage medium had to be made between large rubber-tyred trucks and smaller trucks delivering to semi-portable hopper feeding onto a conveyor belt. Capital expenditure in both cases was estimated as roughly equal. Operating costs and maintenance charges, however, were estimated as appreciably less for the belt haulage since less manpower would be required, maintenance costs for a small and constant number of small trucks would be much less than for an increasing fleet of larger trucks, and no maintenance of truck roads would be required. At this mine a 36 in. belt was to be extended in 2,000 ft. sections with truck hauls kept always below 3,000 ft.

Maintenance

The larger a machine grows the more important becomes properly scheduled and planned maintenance. Work study can reduce the time required for routine part replacement, as instanced by experience at the Hanna Coal Mine, a large open pit undertaking. It formerly took 14 hours to change a shovel bucket whereas it now takes only 5 hours; the "standard" eight-hour procedure for changing a crawler has now shrunk to two hours. This has brought about a decrease in average idle time over a 12-monthly period from 27.20 per cent to 16.60 per cent with corresponding improved productivity.

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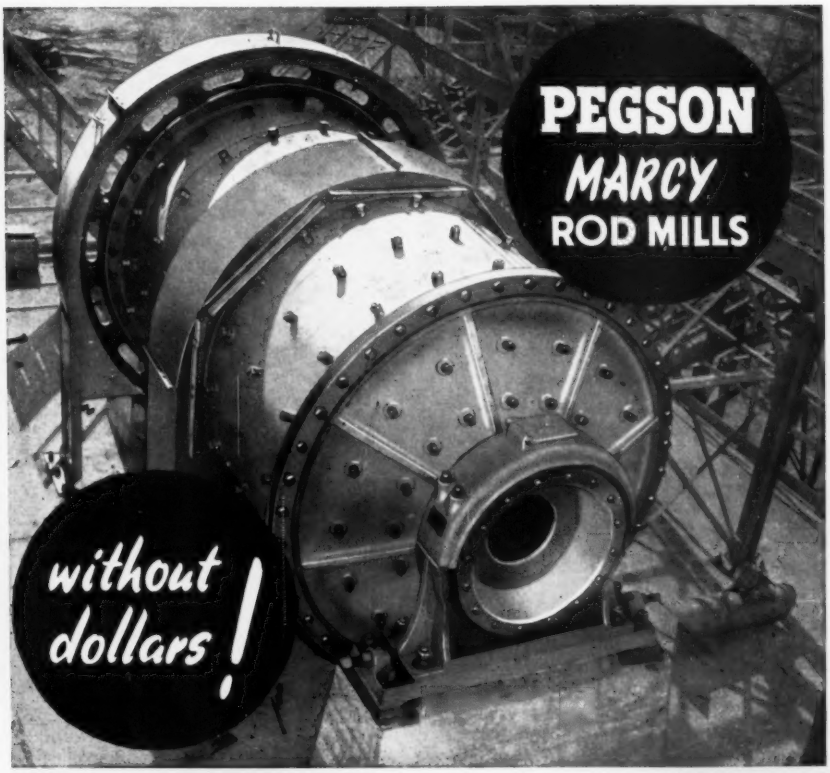
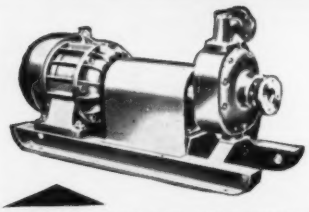


Pegson Marcy Rod Mills are standard equipment wherever fine grinding of ores, wet or dry, is required. With capacities up to 220 tons per hour, they are ideal for processing iron pyrites, copper, lead, zinc, tungsten, antimony, gravel and agricultural lime. Three types are available :— Open End Discharge—for wet or dry grinding of various ores generally reducing 1½ in., 1 in., or smaller feed to as fine as 35 or 48 mesh ; End Peripheral Discharge—recommended where the production of fines is to be maintained at a low degree and Centre Peripheral Discharge—designed to produce a minimum amount of fines, usually limited to a 4 or 8 mesh top size discharge product, Leaflet 409/8 gives full details. Write for your copy and send your material for a laboratory test.



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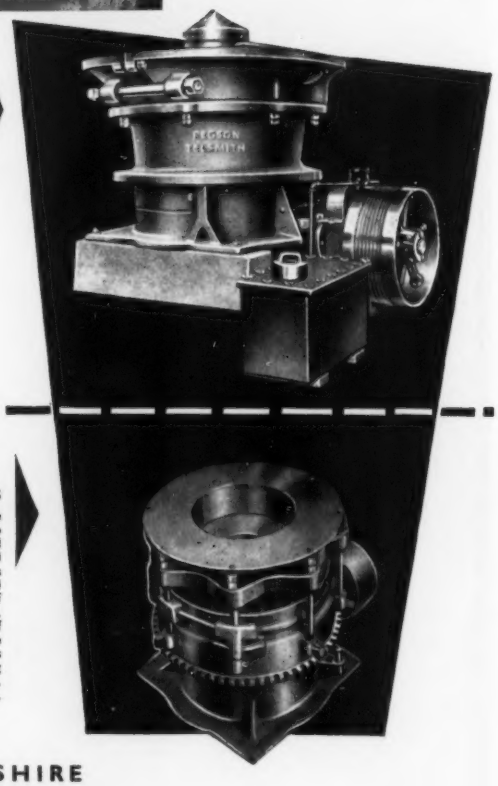

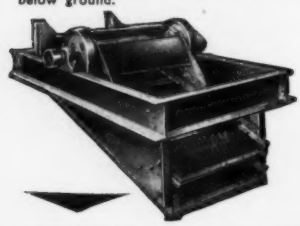

PEGSON-TELSMITH — VIBRATING SCREENS Specially designed for wet or dry screening of sand and gravel, crushed stone, ore, coal and coke. Capacity per square inch of screening area is unusually large, and the output of accurately graded dust-free material is unequalled. Screening efficiencies as high as 98 per cent. Made in a wide range of sizes to suit any duty or tonnage they can be supplied with single, double or triple decks. Leaflet 409/19 gives full details.

PEGSON-TELSMITH SECONDARY GYRASPHERE CRUSHERS

Available in five sizes and three types with capacities from 12 to 200 tons per hour. Constructed on the principle of an inverted pestle and mortar, these crushers have a large unobstructed feed opening. Maximum number of blows delivered at high speed. The resultant product is of cubical shape, dust percentage falls to negligible proportions and wear and tear on crushing surfaces are greatly reduced. Leaflet 409/10B gives full details.

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Mineral Dressing

By F. B. MICHELL, B.Sc., A.C.S.M., M.I.M.M., M.I.Min.E.

DURING the year two unusual events of internation importance occurred in Europe. The first was the inauguration of the first International Ore Dressing Congress which was held at Goslar, Germany, and proved to be a great success, being attended by delegates from no less than 21 countries. The other was the publication of a report of a technical assistance mission of O.E.E.C. dealing with the mining and dressing of low grade ores, which highlighted the increasing importance of low grade and complex deposits as well as the need for expansion in mineral dressing education and research.

Comminution

More has been heard about the use of impact crushers, particularly from Germany where these machines have been employed on a much more extensive scale than elsewhere.

A new model of the Epra type single rotor breaker has been announced by Klockner-Humboldt-Deutz A.G. and is available in different sizes with feed openings up to 59 in. sq. and hourly capacities of approximately 300 tons. With these impact breakers it would seem that the higher the impeller speed, the higher the operating costs, the higher the blow-bar wear and the finer the reduction. When the number of blow-bars on the rotor is increased, the crushing capacity is increased, whilst the question of clearance between blow-bars and striking-bars is most critical, closure of gap decreasing product size.

Horsepower requirements are relatively low and although not efficient on tough dense rock, or suitable for sticky ores, they give excellent performance on brittle materials. Furthermore, this type of machine often crushes selectively and with proper screening can effect a concentration stage on some ores. For example, at Mechernich, screening after crushing in impact mills is an important stage in the concentration process.

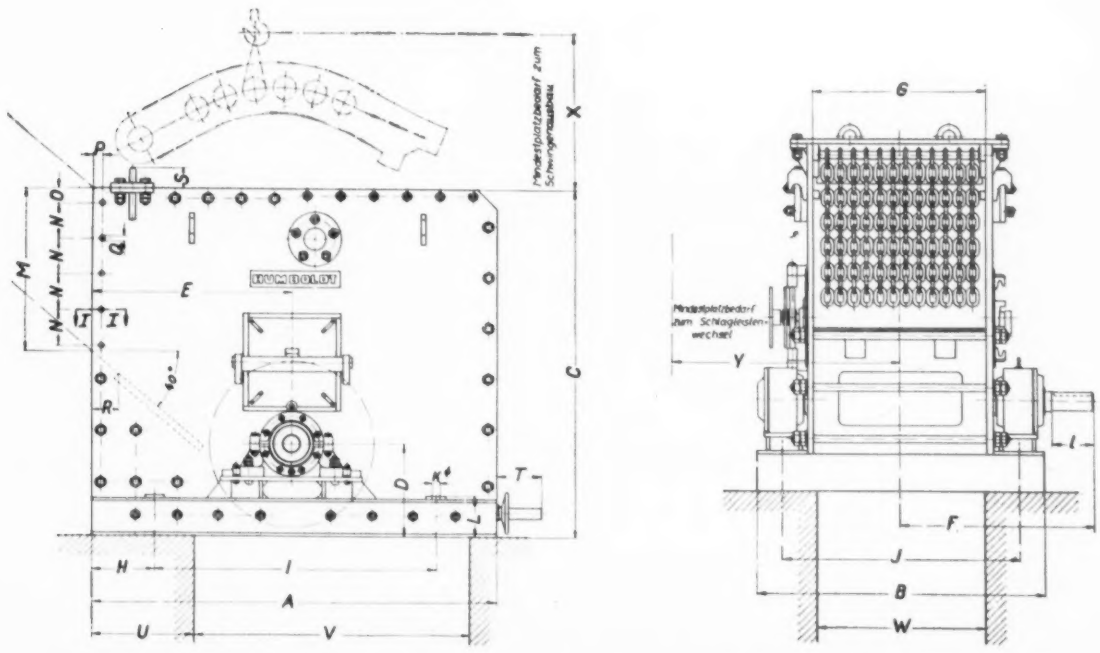
The effect of selective comminution on pegmatites containing cassiterite has also been investigated in Germany by Hubert Schranz and Lothar Wenz, who consider that impact crushers are preferable to cone crushers for this type of ore.

A double movement jaw crusher has been described from Germany, which comprises two swinging jaws and is said to have a rapid discharge and to produce a relatively small degree of over-crushing.

A 36 in. x 48 in. overhead eccentric type of jaw crusher was also developed by Denver Equipment Co. for primary crushing duty.

The principle of using rock to grind itself has attracted attention for a number of years and although very little has been heard for some time, the Aerofall mill now appears to be achieving a fair measure of success. The machine is simply a short, large diameter cylinder revolving at high speed into which material up to 18 in. in size can be broken to any desired fineness by impact on itself. A small ball load is sometimes added on certain ores, and the ground product is removed by air-sweeping the interior of the mill. Although the machine is essentially for dry grinding it will readily tolerate 3 to 4½ per cent moisture and in certain cases as much as 12 per cent by applying heat to the air intake.

Units up to 17 ft. in dia. are in operation on material such as asbestos, iron, gold, uranium ores and quartzite and the makers claim that the capital cost of plant can be



Diagrammatic illustration of the Epra type single rotor breaker manufactured by Klockner-Humboldt-Deutz A.G.

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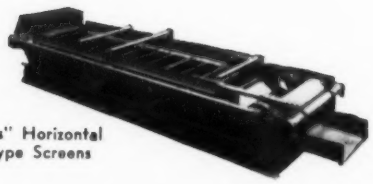
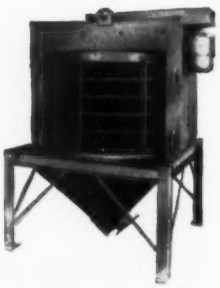
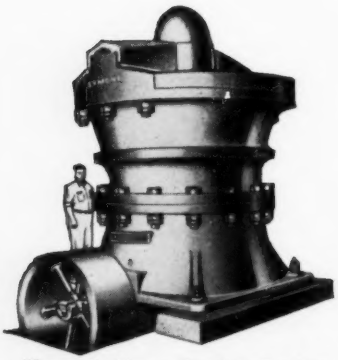


"Symons" Horizontal "F" Type Screens

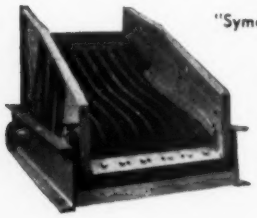


"Symons" Rod Deck Screens

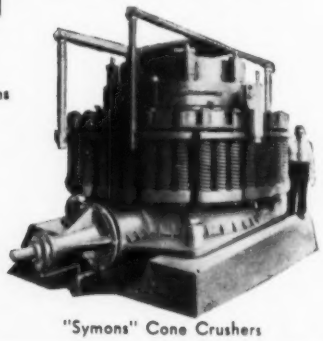
"Symons" "V" Screens



"Symons" Primary Gyratory Crushers



"Symons" Vibrating Bar Grizzlies



"Symons" Cone Crushers

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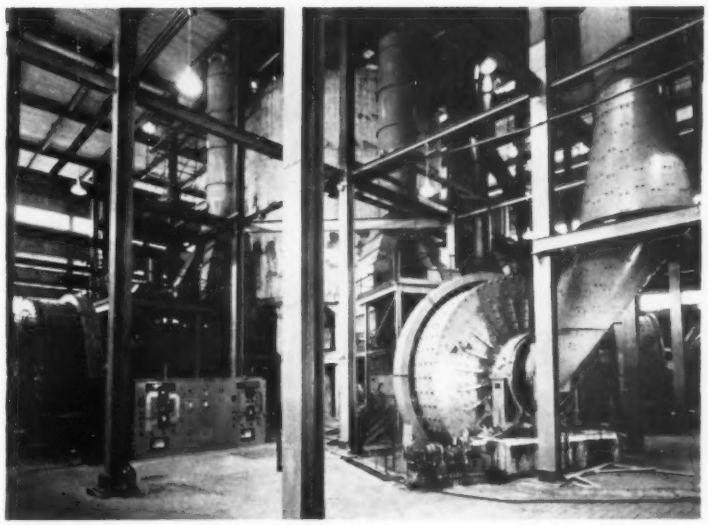
reduced by as much as 40 per cent in some cases, whilst operating cost may be reduced by a like amount. It is also claimed that better metallurgical results can be obtained, which indeed seems likely in some cases owing to the increased surface activity of the finished product.

It is interesting to recall that the first mill of this type was developed in 1932 and was known as the Hardinge-Hadsel mill employing wet reduction. An interesting account of the development of this method of grinding has been given by Harlow Hardinge, who discusses the pros and cons of wet and drying grinding and points out that, although the basic principle is sound, there are many pitfalls to be avoided.

Allis Chalmer engineers have again supplied further valuable data about milling. In comparing overflow and end peripheral discharge mills these workers have found that for a reduction ratio of about 16 to 1, the efficiency of the two mills was almost equal. At lower reduction ratios the overflow mill was more efficient and, at a higher reduction ratio, the end peripheral discharge proved more efficient.



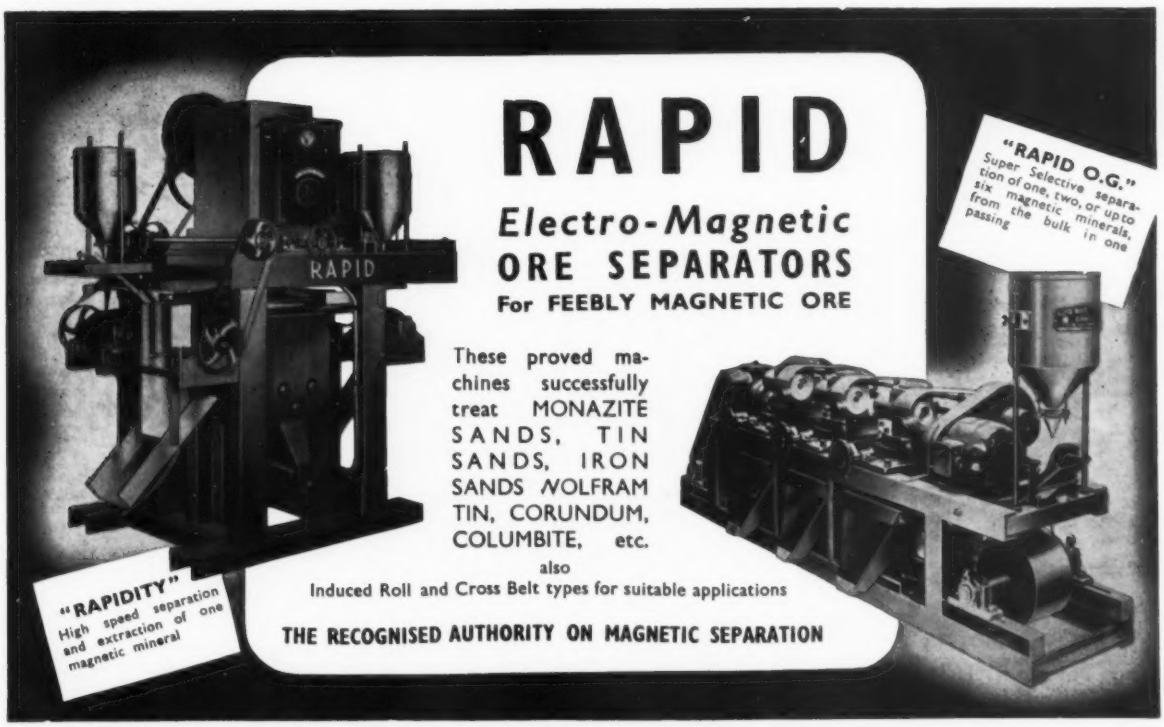
The Normandie Plant of Asbestos Corporation Ltd., Black Lake, Quebec, contains six 17 in. Aerofall mills as the main ore reduction units

The control of grinding has been discussed by E. J. Pryor in a paper at the Goslar Congress. At the same time, Fazerberg outlined results of grinding tests on iron ore at Malmberget, the most important findings being :—

(a) The production of new surface area becomes increasingly more difficult, the finer the grind proceeds

(b) A relatively high water content is favourable for the control of oversize in rod milling. When ball milling a fine feed, the thicker the pulp, the greater is the production of new surface per unit of time and per unit of energy.

(c) The production of new surface in fine grinding is 15 to 25 per cent higher when low-level ball mills are used instead of overflow mills, but this increase probably takes place at the expense of greater wear per ton. The energy per unit of new surface is not appreciably affected by the pulp level.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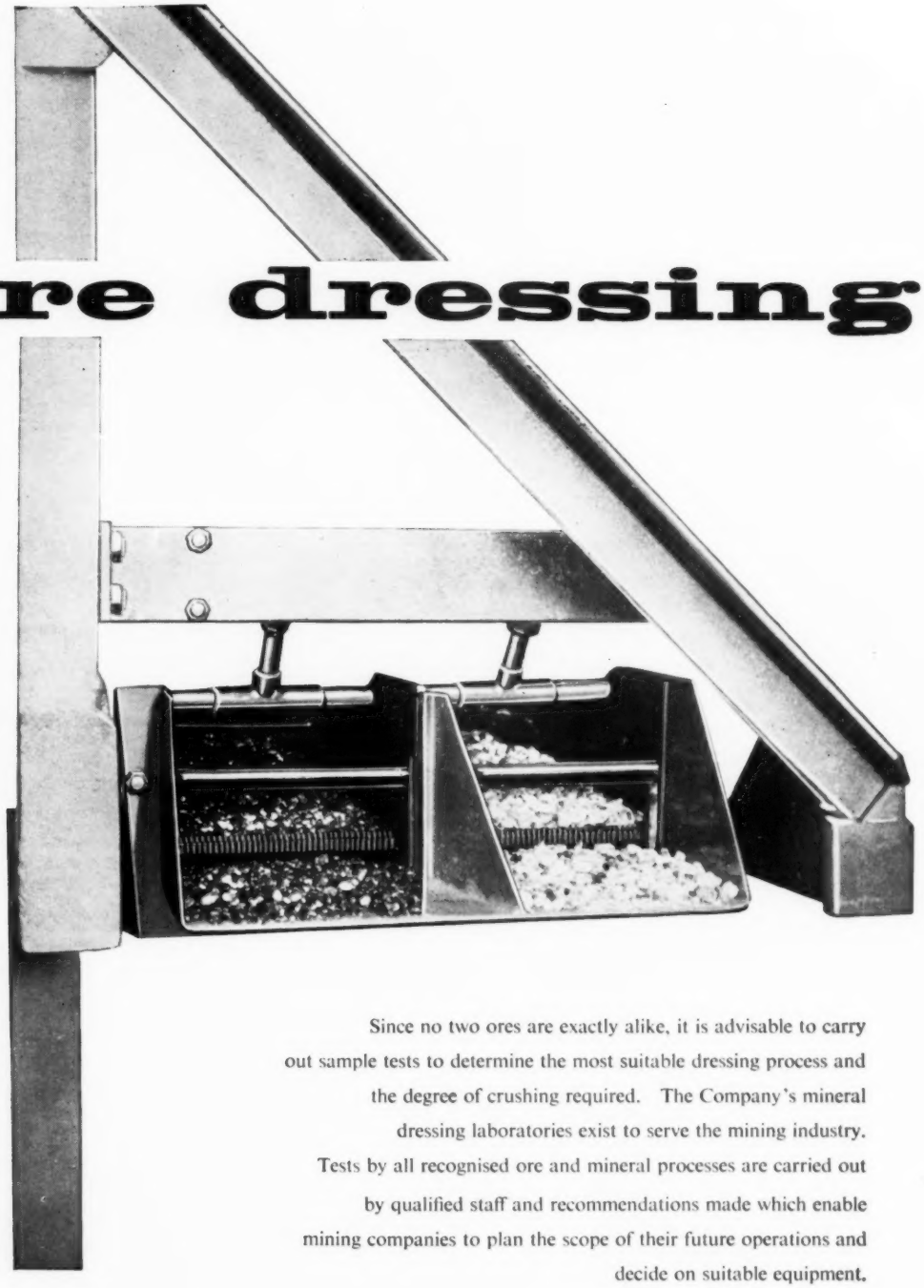
ore dressing



Since no two ores are exactly alike, it is advisable to carry out sample tests to determine the most suitable dressing process and the degree of crushing required. The Company's mineral dressing laboratories exist to serve the mining industry. Tests by all recognised ore and mineral processes are carried out by qualified staff and recommendations made which enable mining companies to plan the scope of their future operations and decide on suitable equipment.

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(d) A charge volume of 40 - 45 per cent is suitable in fine ball milling but 43-50 per cent is recommended for maximum capacity.

(e) Within certain limits, an increase in the specific surface of the grinding media results in higher capacity and less power per ton.

(f) The capacity of fine grinding mills increases proportionately with speed up to 100 per cent of critical, but probably occurs at the expense of economy above 70 per cent.

(g) The type of liner affects the new surface produced and the energy reuired. Smooth liners are recommended for high speed mills.

(h) The production of new surface in ball milling is proportional to the mill length and to D2.5.

(i) The production of new surface is not noticeably affected by operating in closed circuit.

(j) Power consumption and wear per ton in fine ball milling appears to be lower at slower speeds, higher pulp level and lower charge volumes than would be recommended for maximum capacity.

It is interesting to note that some of these findings confirm those reported previously.

An interesting mathematical explanation of the increased efficiency reported from Copperhill last year has been suggested by Zannoras who concludes that one should use the smallest possible balls of the highest possible specific gravity and employ a feed size related to the strength of the material (i.e. a finer feed for a harder rock). He also suggests that the speed, ball load and dilution should be adjusted to give the kinetic energy for producing the right unit stress equal to the crushing strength of the rock.

Nathaniel Arbiter has also suggested a method for accurately predicting the performance of tumbling mills based on operating data, in which no assumptions whatsoever are made as to grinding theories. The method used is based on dimensional analysis.

Sizing

Probably the most interesting development in wet screening is the D.S.M. Sieve Bend primarily designed for operating at about 0.5 mm. This is extremely simple, consisting of a curved bar screen with the bars at right angles to the flow, which is introduced tangentially to the curvature of the screen.

For screening at 0.5 mm. stainless steel bars are used about 2 mm. wide and spaced 1 mm. apart. In operation, the layer of feed moving over the bars becomes thinner because a layer about 0.25 mm. in thickness passes through the slot, dragging particles smaller than 0.5 mm. with it. Larger particles in the main, however, pass over the slots. The screen efficiency is said to compare satisfactorily with the normal type whilst capacity is high—a screen 1 sq. m. in area will handle 200 cu. m. of pulp per hr.

For some time mineral dressers have been finding increasing use for the hydrocyclone, so that it is not surprising to find that the Chemical, Metallurgical and Mining Society of South Africa recently held a Symposium solely devoted to the subject.

The hydrocyclone has become well-established in the field of mineral dressing and is now being extensively used in secondary grinding circuits. By using units ranging from 200 to 20 mm. in dia., it is possible to classify kaolin to the desired fineness for industry: 10 to 20 mm. cyclones have also been employed for separating chalk at approximately 10 microns. Low pressure cyclones deviating from the original Driessen type can operate on coarser material but are not as efficient, although it may be possible to increase the size of cut to 300 microns by operating the cyclone in a horizontal position.

The chief drawback to the hydrocyclone is that any variation in feed conditions is immediately reflected in the size distribution of the overflow. Some of this can be eliminated by control of the spigot orifice, but the machine does not seem to possess the elasticity of the mechanical classifier in this respect.

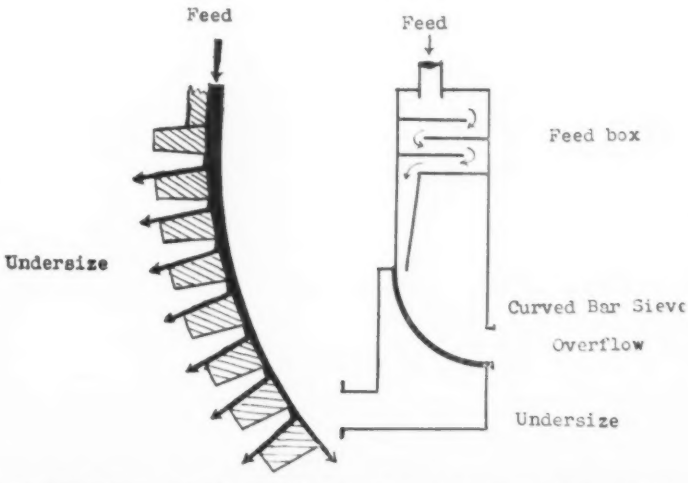
From observations at the Johannesburg Symposium, it would appear that feed pressures need not be very high to obtain normal efficiences in a range 48 to 325 mesh. In fact, in some cases it has been possible to dispense with feed pumps and operate with a comparatively small feed head approaching that used in the open top cyclone described by Emmett and Dahlstrom in 1953.

When such low pressures can be employed, wear is greatly reduced.

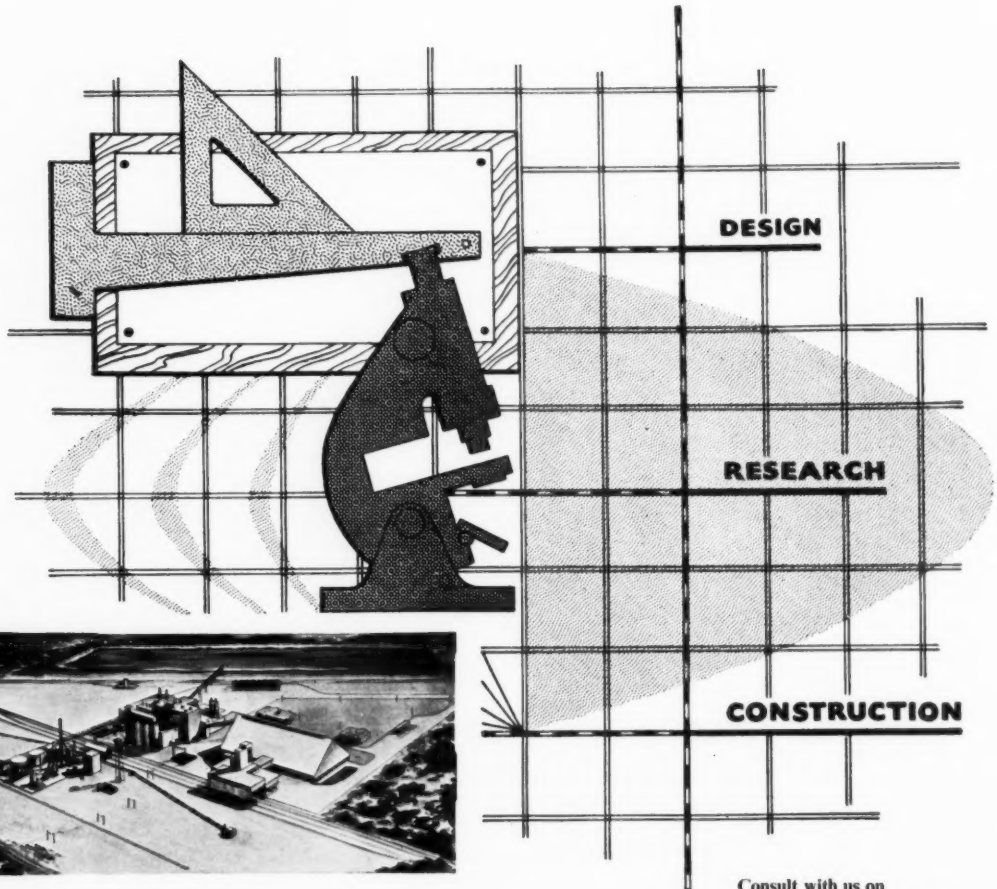
With the same feed dilution, the efficiency of the cyclone does not appear to be higher than other means from tests carried out on certain mines on the Rand. Allowing for wear and pumping, the operating costs of hydraulic cyclones compare very favourably with the conventional rake classifiers in grinding circuits, whilst the capital cost is much lower.

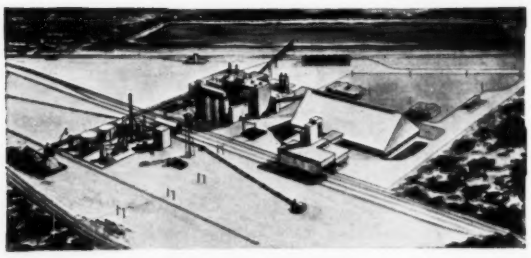
When used in gold milling hydrocyclones appear to possess certain other merits; the amount of gold locked up in the milling circuit is reduced; they act as a concentrator of high sp. gr. minerals, so that an improved differential grind is possible resulting in better recovery during amalgamation and possibly subsequent cyanidation; maintenance costs are reduced; there is less chance of theft and the accident risk is lower.

For some years the inventor of the Tedman separator has been working on a radical design of classifier, details of which have recently been announced. It is said to grade material efficiently in the size range 3 - 0.10 mm. and units having capacities of ½ ton to 2 tons per hr. are being manufactured. The classifier consists of a horizontal cylindrical body, having a coarse internal screw thread, and is provided with tangential inlets for either the feed or water at each turn, whilst the products are discharged axially through the conical ends.



The D.S.M. Sieve Bend. On left is an enlarged view showing operation of the curved sieve, and at right a general view





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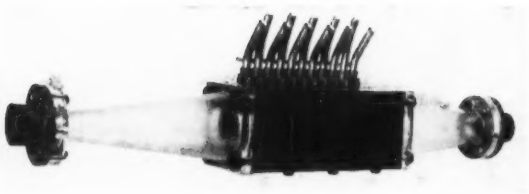


The Tedman Separator

On entering through two or more inlets arranged tangentially, the solids are forced to the periphery by centrifugal action travelling around the grooves of the internal spiral and are classified by the introduction of water through the remaining inlets. The feed pressures are low, being around 5 to 10 lb. per sq. in. when the velocities of the solids in the grooves are in the order of 10 ft. per sec.

A very interesting design has been developed in the American chrome company's plant in Montana in connection with the preparation of table feed. In gravity concentration good classification of the feed is a pre-requisite for efficient tabling, and if the tables can be operated with a minimum of change in feed conditions, few adjustments to them are necessary.

Realizing the importance of classification two types were tested but the results were not good. One classifier without any density control did not yield a well sized table feed and a second type in which the spigot opening was controlled tended to produce surging spigot discharges, although they were well sized.

As a result of these observations, it was decided to modify the design so that the discharge was operated at a set rate and the density in the sorting column maintained by controlling the amount of water added. To this end an intermittent discharge was employed, set to open 40 times per min. whilst the amount of "rising-current" water was controlled in relation to the density in the classifier column. This arrangement is reported to work exceedingly well and although there is a rapid surging of each spigot discharge, the surge is flattened out in the launders feeding the tables.

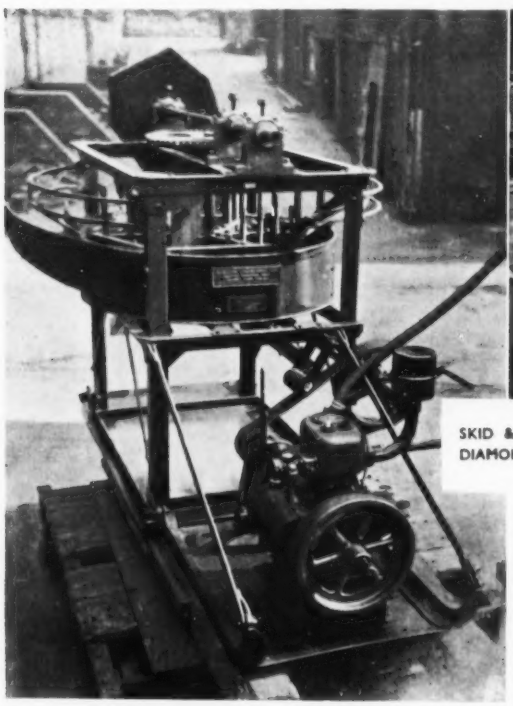
Gravity Concentration

An interesting discussion of jigging theory has been presented by Vissac, showing the importance of correct stroke characteristics.

The writer points out that for equal falling particles, a separation can be effected during the initial acceleration period by virtue of the specific gravity differential and that with a correct downstroke (suction) ideal conditions can be achieved. On the other hand, on the pulsion stroke, the motion tends to interfere with the separation of equal falling particles.

The most suitable speed for a 1 mm. feed is said to be between 120 and 240 strokes per min., although it is not possible to move the water at such speeds in large jigs. In consequence, the large coal-washing jigs run at a slow speed so that the water follows the natural pulsations. The desirable form of the surges in a jig is also discussed as well as the question of ragging and its shape.

The Fanning ore-concentrator has been developed by Carpco of Jacksonville, Fla., and consists of a tapering trough with a deflector and concentrate splitters, at the point where the pulp leaves the trough. It is said to handle pulps at 65 per cent solids and has no moving parts. Performances quoted by the makers are good and the machine has a high throughput.



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When applied to Columbite, the carrot shaped particles are imbued with a dual motion. They rotate on their longitudinal axes and at the same time turn end over end, but all the while all bouncing movement is strictly eliminated. Special instruments have made it possible to observe the impact of this effect at the mesh surface during the operation of the machine, when it was shown that the spinning motion helped the carrot shaped particles to pass readily through the screen apertures, while the end over end movement rendered it impossible for any material to stick in the mesh and cause blinding.

Cascade Sieving Units, Screening columbite at the Jos Mill of Tin and Associated Minerals.

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Dense Media Separation

One of the most interesting developments in dense medium separation is the new Stripa process developed in Sweden, and fully described by J. Svensson in a paper read at the Goslar Congress.

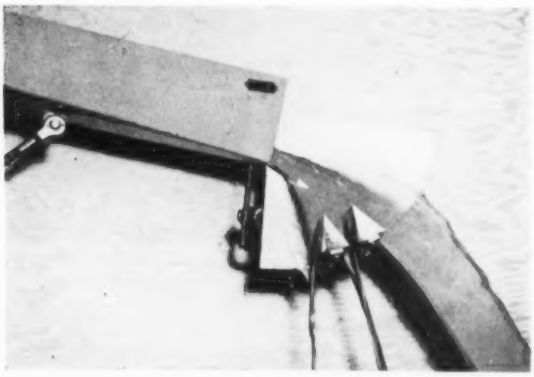
Separation is achieved in a dense-medium bed which is continually transported in a shaking trough, the comparatively coarse solid particles in the bed being kept fluid or " in teeter " by means of a rising current of water such as is used in the Chance Cone.

This water is supplied through a perforated base and as the feed travels along the trough it separates, the upper and lower portions being removed by a splitter at the end of the trough. Using a table concentrate consisting of magnetite and haematite (65 per cent Fe) a separating gravity of 3.3 is obtained and a 20 in. wide trough will handle 40 tons per hr.

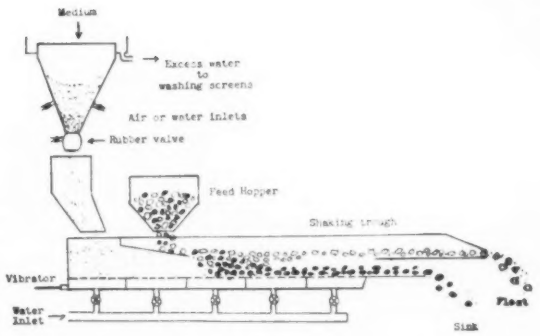
Atomized Ferrosilicon

Atomized ferrosilicon is now being manufactured for medium preparation and has different properties from the ground material. For example, the atomized ferrosilicon consists of spherical particles having smooth surfaces, which also has a certain case hardening due to quenching in manufacture. This is said to be an advantage, since the spherical shape is responsible for lowering the apparent viscosity of the suspension as well as reducing the corrosion, because attack commences at points. Furthermore, in grinding ferrosilicon, iron is abraded from the mill and becomes mixed or even rolled on its surface which strongly promotes the formation of rust. As a result, starting after a shut-down is much easier. It is claimed that whilst maintaining a viscosity of 12 centipoise, a pulp density of 3.45 can be attained with the atomized material compared with 3.3 for the ordinary ground variety. When special material is used, densities of 3.7 to as high as 3.9 can be maintained. No data are yet available on such high operating densities but a density of 3.45 is now being maintained in one large plant and losses of medium are claimed to be lower.

It has been suggested that some of the particles in an atomized ferrosilicon may be porous and thus lower the effective density as well as increase the apparent viscosity and tendency to oxidize if they occur at the surface, but the makers claim that although the porosity is noticeable in material above 0.15 mm. there are few pore in −0.1 mm. material. Most of the pore are at the surface, i.e. open ones, so that there is no appreciable effect on the density. Most of the atomized ferrosilicon used is well under 0.2 mm. and the proportion of −60 micron material is in excess of 60 per cent.



The Carpco Fanning Concentrator



The Stripa Separator

Flotation

A number of new flotation plants have been described in the technical literature, but as far as equipment is concerned there is little new.

It may be widely supposed that the simple Callow cell in vogue many years ago has long since been replaced, but at Kennecott's Hayden Concentrator, Callow type cells have been used since 1917 and various modifications made. Other flotation machines such as the air-lift or matless and mechanical types have been run alongside the Callow cells, but have failed to handle tonnages or give metallurgical results equal to the modified Callow cells on this particular property.

The present cells are simple troughs using a four-ply cotton fabric as the mat. Maintaining the mats in good condition is most important and new mats are treated with fuel oil, which retards the lime precipitation within the pores of the mat and adds to the operating life.

A series of investigations on full size plant have been conducted to determine the effect of operating variables and factors in cell design on coal flotation cell capacities. It was found that a set of baffles around the bottom of the cell improved the recovery and lowered the power consumption, but that super charging lowered the recovery. The depth of the cell was also investigated and it would appear that the recovery is by no means related to the depth.

Gaudin and Fuestenau have further investigated quartz flotation with cationic collectors, using streaming potential techniques and measuring the zeta-potential of quartz as a function of the concentration of dodecylammonium salts at different pH values.

These experiments have demonstrated that absorption of dodecylammonium ions takes place as individual aminium ions until a certain critical concentration is reached in the double layer, at which point the absorbed collector ions begin to associate into patches of ions, called hemi-micelles. It is shown that because of its effect on the surface, the pH controls the absorptions of dodecylammonium ions, and the hemi-micelle hypothese leads to interesting speculations concerning the value of assisting collectors and the part of non-ionized collecting constituents of flotation systems.

The use of various xanthates has been discussed by G. Erberich in a paper entitled " Experiences with Xanthates of Higher Alcohols ". It is pointed out that their specific properties vary considerably with the type of ore treated and that no universal rule exists for the application of the different xanthates. In most cases, practical results fall short of theoretical expectation, but the careful choice of reagents nevertheless often produces remarkable results. For example, although it is generally supposed that the activity increases with the length of the carbon chain, there

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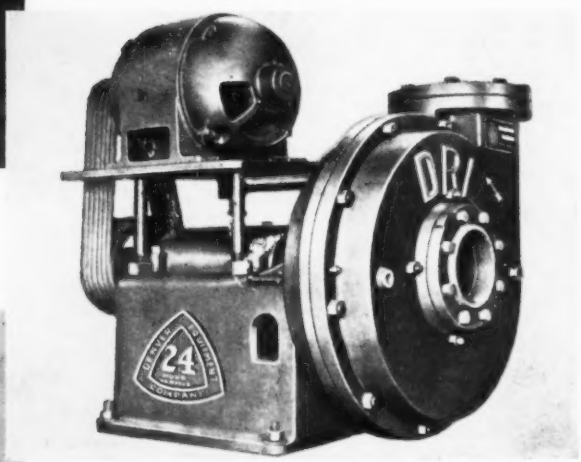

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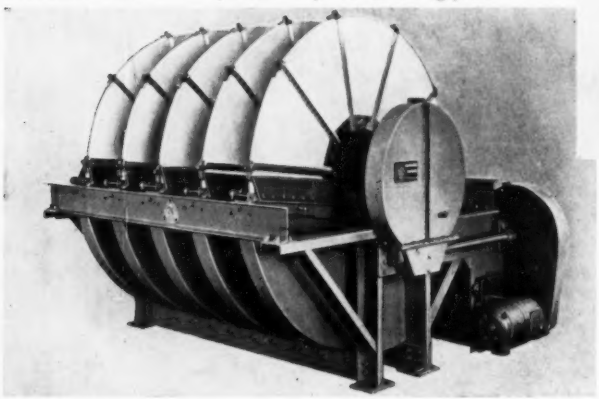

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is considerable divergence due to various factors such as the presence of metal ions and absorptive slimes. In the case of many lead-zinc ores, butyl xanthate often produces extraordinarily good results on galena, whilst with sphalerite it was found that recovery increased with an increasing length of the carbon chain when chemically pure xanthates were used.

When technical reagents were employed, however, butyl xanthate was superior to the amyl or hexyl compounds. When oxidized lead-zinc ores were tested hexyl xanthate was superior to amyl xanthate and when floating pyrite in lime-alkaline or in acid circuits, xanthates with a longer carbon chain failed to be efficient.

Experience has also shown that, when using a combination, it is usually advisable to add the weaker xanthate to the first part of the circuit and the stronger into the final cells. When mixed solutions are employed the mixture often assumes the character of the higher xanthate.

The problem of separating pyrite and arsenopyrite by flotation has also been discussed by H. Kirchberg, who points out that both minerals vary considerably in their response to flotation.

In tests carried out at Freiberg on an ore from the pyritic-lead formation nearby, it was found that with a low arsenic ore (below three per cent As), satisfactory results could be obtained by replacing the lime with soda-ash, when amyl xanthate proved the best collector at a pH of 8.0 and most of the arsenopyrite was depressed.

In the case of high arsenic ores, the technique failed and a better method was to float as much arsenic as possible first after activation with copper sulphate in a lime alkaline pulp, but separation was not satisfactory.

The efficiency of fluorinated collectors has been studied by Cooke and Talbot. Most fluorinated compounds are adsorbed strongly on solid surfaces and yield films that exhibit larger contact angles than films of the corresponding hydrocarbons, the large contact angles probably result from the terminal—CF_3 group.

In these tests, haematite was chosen to represent non-sulphides and pyrite to represent sulphides, and fluorocarbons were compared with hydrocarbons.

With haematite the C_8 and C_{11} perfluorocarbozylic acids are more effective collectors than their hydrocarbon analogues, but since they are stronger acids they must be employed in more acid circuits than ordinary fatty acids.

It was also found that perfluoro-sulphonic acids are collectors for haematite at low reagent concentration, whilst the fluorinated quaternary compound is a selective collector for quartz and gives an excellent separation of quartz from haematite at pH of five or above, even with ores where the iron slime has not been removed.

The fluorinated xanthates CF_3CH_2OCSSK and CF_3CF_2-CH_2OCSSK are selective collectors for pyrite only at low pH, but are less stable in aqueous solution than the corresponding hydrocarbon xanthates.

It is stated that none of these fluorinated reagents are available commercially at present.

Ultrasonic Emulsification

The value of employing ultrasonically emulsified collecting reagents in flotation has been demonstrated by Sun, Tu and Ackerman, who point out that as early as 1927 the preparation of emulsions using ultrasonics was demonstrated. These workers show that whilst some highly lipophilic collectors such as Armeen 18D are much more difficult to emulsify in water than the highly hydrophilic types, such as potassium ethyl xanthate and Turkey red oil, most materials can be emulsified with the addition of an emulsifier. It has also been found that the emulsification can be facilitated by increasing the sound intensity, but it is more difficult to emulsify a high concentration of the collector.

Experimental flotation shows that the ultrasonically emulsified collectors are more effective than unemulsified collectors. This is particularly true of the insoluble and very slightly soluble types, but in all cases an improvement was shown. With a paraffin wax or coal tar as a collector for bituminous coal, the recovery improved from between 40 and 50 per cent to over 80 per cent.

Magnetic Separation

An interesting paper by R. Tillé and W. Kirkpatrick reviews methods of making susceptibility measurements and the applications of magnetic separations on an industrial scale.

It is understood that, since the introduction of the Davies Model 45, laboratory and prospecting magnetic separator, orders have already been received from Malaya, Nigeria, Indonesia, Sierra Leone and the United Kingdom.

A novel design of magnetic separator developed by Titanium Corporation has been producing high grade ilmenite for the past 18 months in Natal ; it is said to have a high capacity, a higher recovery and unusually high concentration in comparison with conventional separators.

The machine consists of pairs of rolls having specially designed surfaces, which form the magnetic system and rotate toward each other into the incoming feed stream falling between the rolls. Ten of these pairs are arranged one upon the other, so that the feed receives repeated treatment and the magnetic fractions are diverted into chutes on either side.

The success of the separator hinges on the surface design of the rolls and is described as being scabrous or having a surface similar to a rat-tail file The form of the peaks and valleys formed in this way is most important and the pitch and depth of the cut surface vary with the mesh and/or the magnetic susceptibility of the particles being collected. Most of the field is developed on the peaks, causing the magnet to work on a mono-layer of incoming ore particles and to accept only those ilmenite particles for which the surface was designed. Magnetic particles which fall in the grooves are thrown back into the outgoing stream by the centrifugal force.

It is also interesting to note that work on high intensity wet magnetic separation is being carried out by Jones at Camborne School of Mines and at the Colorado School of Mines who has developed a new type of separator.

Electrostatic Separation

Electrostatic separation is being employed increasingly, especially in the dressing of alluvial tin concentrates both in Nigeria and Malaya, and is now entering the non-metallic mineral field. In many cases the minerals are electrically non-conductive and it is necessary to activate them by suitable conditioning before separation. Briefly, the principle is to condition with a reagent which forms a conducting coating on the mineral surface, thereby making use of varying surface characteristics of the minerals.

This process was used for the first time in a dry dressing plant of a Bavarian kaolin works. The dried residues from the kaolin plant are treated electrostatically making a high grade ceramic spar and very pure quartz sand, using a Lurgi plant. The feldspar content of the size fractions ranging from 3 to 0 mm. (which are treated separately) varies from 3 to 18 per cent and a final spar concentrate containing 84 to 93 per cent is made whilst a maximum of 0.1 per cent feldspar remains in the quartz sand.

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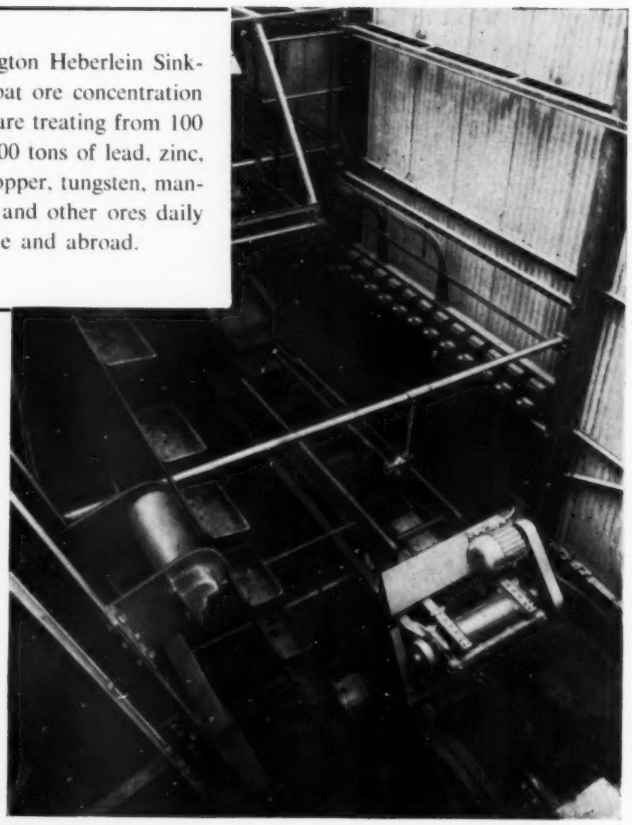

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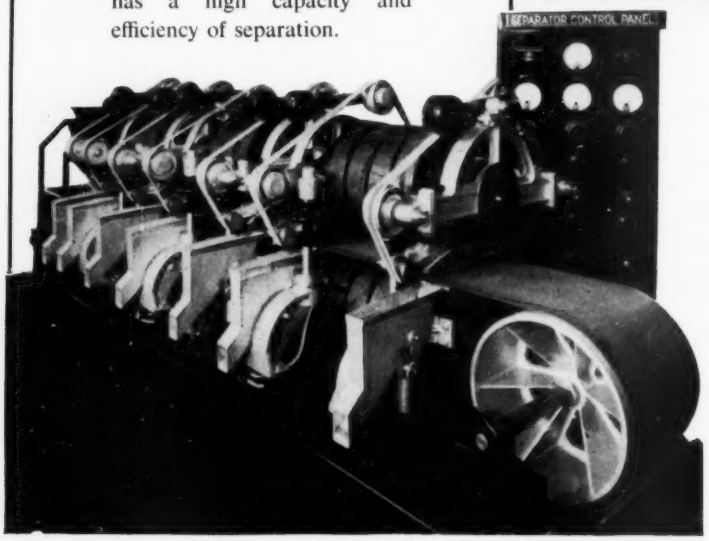

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In a similar manner fluorspar, barite, kyanite, mica, talc, and asbestos can be processed, although they are practically non-conductive.

According to Stieler, considerable possibilities lie in developing such separations. Plants equipped with Lurgi machines are also treating monazite ; in conjunction with magnetic separation a monazite over 95 per cent pure and with a yield of 90 per cent can be made.

Operating costs are largely due to drying and account for 60 to 70 per cent; this varies from 1.00 to 2.00 DM per ton but may be increased to 3 or 4 DM per ton if some special pre-treatment is necessary.

Concentration of Specific Minerals

Gold :—The use of the hydrocyclone in grinding circuits is discussed earlier in this article and would appear to improve recovery due to selective grinding in certain instances.

Chad Norris has given a very interesting account of continuous concentration and amalgamation undertaken on the Gold Coast to replace the batch treatment (Barrel amalgamation) usually employed to deal with corduroy concentrate.

The new flowsheet involves using Johnson concentrators after the first stage of milling and making a concentrate, which is cleaned in slower speed machines of the same type. The final gravity concentrate is dewatered and amalgamated in a Titan amalgamator, which is cleaned up once every two days.

The amalgamator tailing is next treated on a table to make a sulphide concentrate, which is roasted, and a tailing which returns to the classifiers before the secondary mills. The overflow from this circuit is treated by flotation and the resulting concentrate roasted and cyanided.

In operation, the recovery of free gold is equal to the old procedure and there is no sign of gold or amalgam on the table. In addition there is less overgrinding of sulphide minerals and an improvement in overall recovery, the table now recovering as much as 35 per cent of the gold formerly caught in the flotation circuit, so that the flotation feed is lower grade but the average grade to the roaster is higher.

This Titan amalgamator has been extensively used on dredges.

Tin :—The tendency is to replace hand dressing as well as to aid purely gravity concentration in the alluvial field with more magnetic and electrostatic separation, together with flotation to deal with certain sulphide minerals which may be present.

More mechanization of the final concentration stages of lode ores has taken place both in Cornwall and Malaya, continuous classification and table concentration replacing the older batch methods.

Details of work on tin flotation in Germany have been published in which the efficiency of various fatty acid collectors has been studied. In general, the findings are that oleic acid and castor oil acid are good collectors, but linoleic, palmitic and stearic acids are unsuitable.

Oleic acid and the castor oil derivative give good results with ammoniacal pulp. Sulphonated and sulphated fatty acids also collect cassiterite and complete sulphonation is unnecessary, but soaps are poor collectors as the enrichment is poor, these collectors being non-selective. Aminosalts also proved good collectors, the best results being obtained with a pH below 6.0. The best combination suggested by these German workers consists of reagent N.G.P. (a special reagent developed for cassiterite), amyl xanthate, coal-tar oil, and flotol in an acid circuit.

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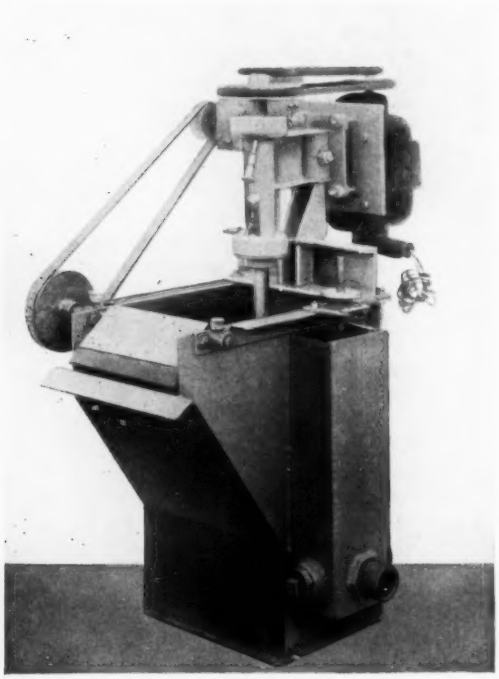

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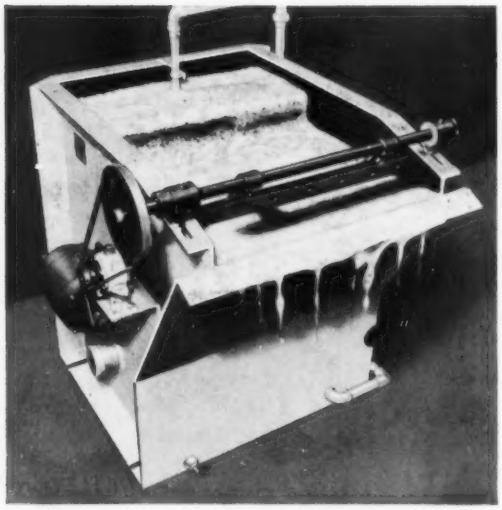

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Uranium :—In a technical publication released by the Canadian department of Mines and Technical Services, details are given of an improved Lapointe picker. Although the original design would not operate on low grade ores, the modified form has made this possible by using a scintillation detector with a sodium iodide valve under the feed belt insuring that each piece is close to the detector.

A new process of uranium extraction has been described in which the ore is leached with carbonate solution and oxygen under pressure to insure that the uranium is in the 6— valent condition. The uranium is recovered from the leach solution by reduction to the tetravalent state, using hydrogen and a suitable catalyst.

At Climax Uranium plant the difficulty experienced with high lime is now overcome by neutralizing with waste acid from roaster gas scrubbers, which converts the lime to calcium chloride and sulphate. The sulphate does not react with the vanadium during subsequent roasting and after dead burning does not set.

After neutralizing the slime is separated in a Dorr sizer, the sand being simply leached whilst the slime is roasting before leaching. The recovery of vanadium is low in the sand treatment section, but since 70 to 80 per cent of the values are in the "slime" or—150 mesh fraction, this is not serious and enables 60-70 per cent of the ore to be treated simply.

The slime material is filtered, mixed with salt, dried and roasted before leaching out the water soluble sodium vanadate. After this operation two stage filtration takes place and the residue is pumped to the counter-current uranium plant where the ore is agitated with sulphuric acid, being filtered and re-pulped four times at carefully controlled pulp density and pH to ensure the maximum recovery of uranium in the ore.

The vanadium rich liquor is acidified using sulphuric acid (pH3) when the complex sodium polyvanadate is precipitated.

Lead and Zinc :—At the Sullivan concentrators, the major recent innovations have been the substitution of Dow—froth for the water—gas tar—creosote—creslyic mixture formerly used, and the introduction of a de-zincing step on what was formerly the final lead concentrate. The de-zincing is carried out by conditioning with sulphuric acid and dichromate in order to depress the lead when the zinc is floated with lime, copper sulphate and isopropyl xanthate.

The recovery of oxidized lead minerals has also been studied by the U.S. Bureau of Mines.

Copper :—At the Boliden Mine, large extensions have been made to the plant since 1947, increasing the output of the mine from 1,000,000 to 1,600,000 tonnes per year. The plant has been described in detail by P. H. Son Fahlstrom, and it is interesting to note how the purity of concentrate is maintained by employing deep flotation cells and stage addition of xanthate so that there is always a slight deficiency. The copper is floated with amyl xanthate in an alkaline pulp. From mixed copper-lead-zinc ores, a lead-copper concentrate is removed in a slightly alkaline pulp and this is re-treated depressing the galena with dichromate, whilst the sphalerite is floated in the usual manner later.

Molybdenite :—In addition to the molybdenite, wolfram, cassiterite, topaz, monazite, pyrite, and chalcopyrite are present at Climax, causing an elaborate flowsheet.

Treatment consists of a coarse grind (43 per cent+100 mesh) followed by flotation of molybdenite using hydrocarbon oil, Syntex (as an emulsifier) and pine oil. The rougher flotation concentrate is cleaned in four stages with grinding and classification between each stage. Cyanide and soda ash are used to depress other sulphides, making a final grade of over 98.5 per cent.

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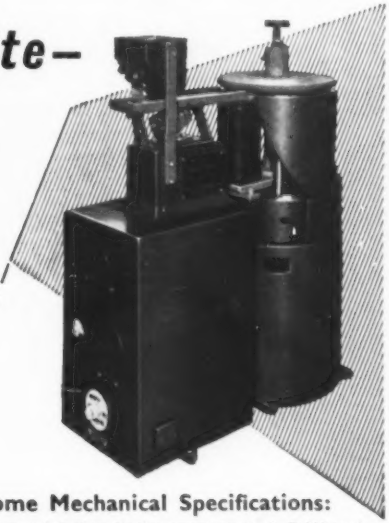

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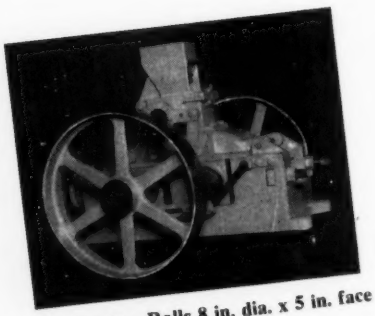

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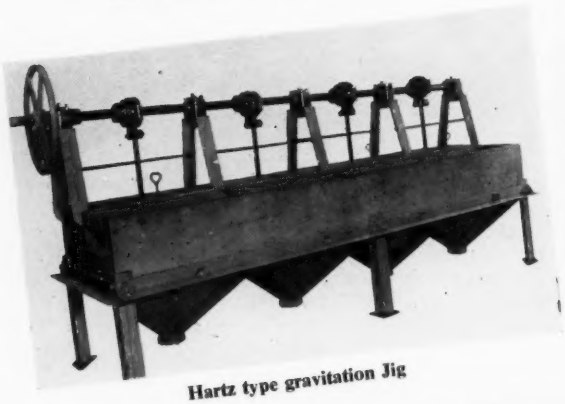

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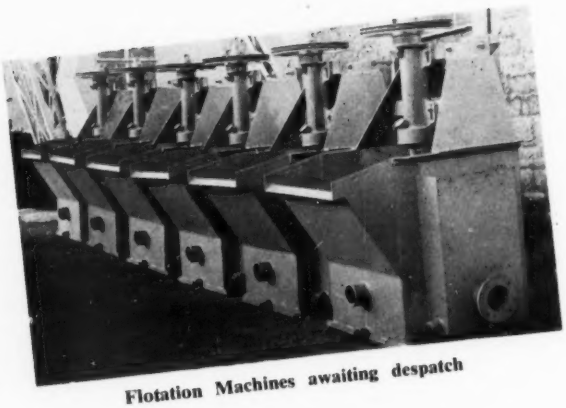
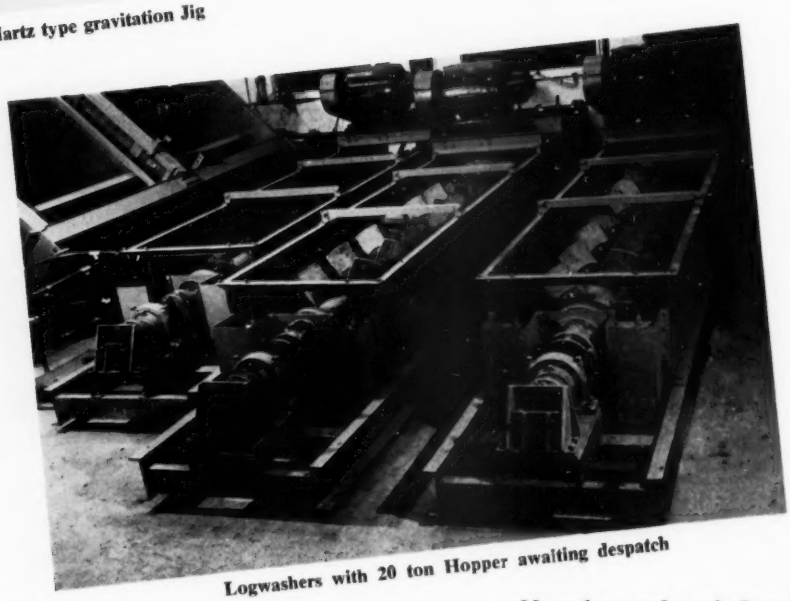


Flotation Machines awaiting despatch



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The rougher tailing is deslimed and treated on spirals, followed by flotation of the concentrate to eliminate the pyrite and concentration on tables. The gravity concentrate is finally dried and passed through a magnetic separator to remove the wolfram and monazite. This mixed concentrate is floated with an amine in a highly acid circuit to separate the monazite, depressing the wolfram with starch. The flotation residue is dried and re-separated. Non-magnetic fractions are treated to make a tin concentrate.

Titanium :—In April, a further large ilmenite plant was put into operation in Florida, which was jointly designed by du Pont and the Humphrey Gold Corporation, employing Humphreys Spirals followed by electrostatic and magnetic separation. The flowsheet is very similar to that used at Trail Ridge, which has proved most satisfactory and has been in operation since 1948.

Iron Ore :—The first pilot plant to demonstrate that the Michigan non-magnetic ores can be rendered magnetic and subsequently concentrated is believed to be that operated by Jones and Laughlin Steel Corporation at Negaunee.

Here the ore is crushed to 14 mesh and fed to a fluosolid reactor where reduction takes place. The reduced ore is then quenched ; passed through a wet magnetic separator, removing some 20 per cent as a tailing. The rougher concentrate is then ground to pass 100 mesh and re-treated, this concentrate being finally ground to −325 mesh, and retreated. The final concentrate is thickened, filtered and pelletized. The pelletized material is then sintered to harden it, when individual pellets also tend to consolidate in grape-like clusters.

Potash Minerals :—Papers were presented at Goslar dealing with the German potash industry and the use of hydrocyclones as concentrators using a medium of density 1.64 as well as table-flotation was discussed. Normally, however, flotation in a saturated solution is employed, using water soluble salts of primary amines with 8 to 20 carbon atoms as collectors.

Mineralogical Techniques

The importance of using and adapting mineralogical techniques for quickly identifying the constituents in mill products has been brought out in a number of papers. There is no doubt that much better use can be made of such techniques not only in connection with ore testing and research but also in examining existing methods and the day-to-day control of plant operation.

In conclusion, it does not seem out of place to refer to a paper by H. Rush Speddon dealing with the concentration of materials other than natural ores by mineral dressing processes. The paper points out that there are several operations in which pyrometallurgical operation could alter the mass so that separation could be effected after grinding. Selective reduction of the iron in ilmenite to metal is possible, followed by grinding and magnetic separation.

Such combination-processes may well have far-reaching future applications in the metallurgical field and it is reasonable to suppose that more pure chemical or metallurgical operations may invade the field of the mineral dresser.

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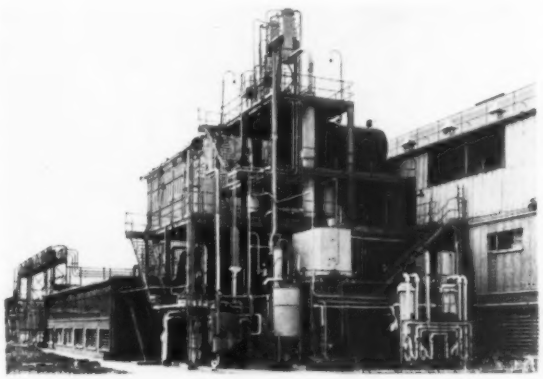
Extraction Metallurgy

By GRAHAM OLDHAM, B.Sc., F.R.I.C., D.L.C., M.Inst.F.

TAKING stock of the year's work on extraction metallurgy is not a simple matter. In the end one must select some twenty or thirty papers or patents which serve to indicate the general trends. Out of the total amount of literature published, such a selection is not altogether an easy one to make. However the choice must be made and this year, as always, we shall endeavour to present as broad a picture of world developments as possible.

Vapour Phase and Gaseous Reduction

During the year, there has been a great deal of published work on the production of titanium. The Kroll process is still favoured by many companies and there have been many interesting variations on the process reported. In this country, the I.C.I. are pressing ahead with the sodium reduction process. The extraction process is being operated at Wilton in Yorkshire where the potential production is 1,500 tons of raw titanium a year and a new fabrication factory is being built at Waunarlwydd in the Swansea area. Much of the year's literature has already been reviewed in *The Mining Journal* (March 30, 1956) and will not, therefore, be considered again.



The titanium tetrachloride plant at Wilton

By courtesy of Imperial Chemical Industries Ltd.

A variation in the Kroll-type process, applicable to the production of either titanium or zirconium, which we have not previously reported, has been the subject of a British patent.[1] A stream of argon is passed over boiling magnesium and, together with the entrained magnesium vapour, is then passed into a reaction vessel where it is mixed with gaseous titanium or zirconium tetrachloride. The titanium or zirconium produced, together with the magnesium chloride, are held in suspension until cold. It is said that by this method a more convenient separation of the metal may be achieved. The titanium or zirconium can then be produced in a pure form by remelting.

The reduction of zinc oxide with carbon monoxide and hydrogen has been investigated by Gerlach and Knacke.[2] The authors have shown that the reaction velocity of the reduction is proportional to the gas concentration. If pure carbon monoxide is employed at atmospheric pressure and a temperature of 1,200 deg. C. the reduction velocity is calculated to be 2.2 tons of zinc per day for every square metre of oxide surface. A new equilibrium diagram for the muffle reactions is given in the paper.

Metal Reduction Processes

Interest in the "rarer" metals has steadily increased during the last decade or so and there has been a corresponding increase in the attention paid to the processes employing as reductants, metals with a greater affinity for oxygen than the metal being prepared. Vanadium is one metal which may be produced by such a process and the Westinghouse Electric Corporation have claimed a process for the production of the ductile metal.[3] The starting point is vanadium pentoxide, which is first of all reduced to the trioxide with hydrogen. It is important that the resultant metal should not contain nitrogen and, since this could be introduced by the use of impure commercial hydrogen, care must be taken that the hydrogen does not, in fact, contain nitrogen. The temperature employed for the hydrogen reduction is approximately 600 deg. C. and the water vapour content of the hydrogen should be such that the dew point is between 40 deg. and 60 deg. The final reduction to metal is achieved with molten calcium at between 900 deg. and 1,350 deg. C. and the product obtained is so soft that it can be formed at room temperature.

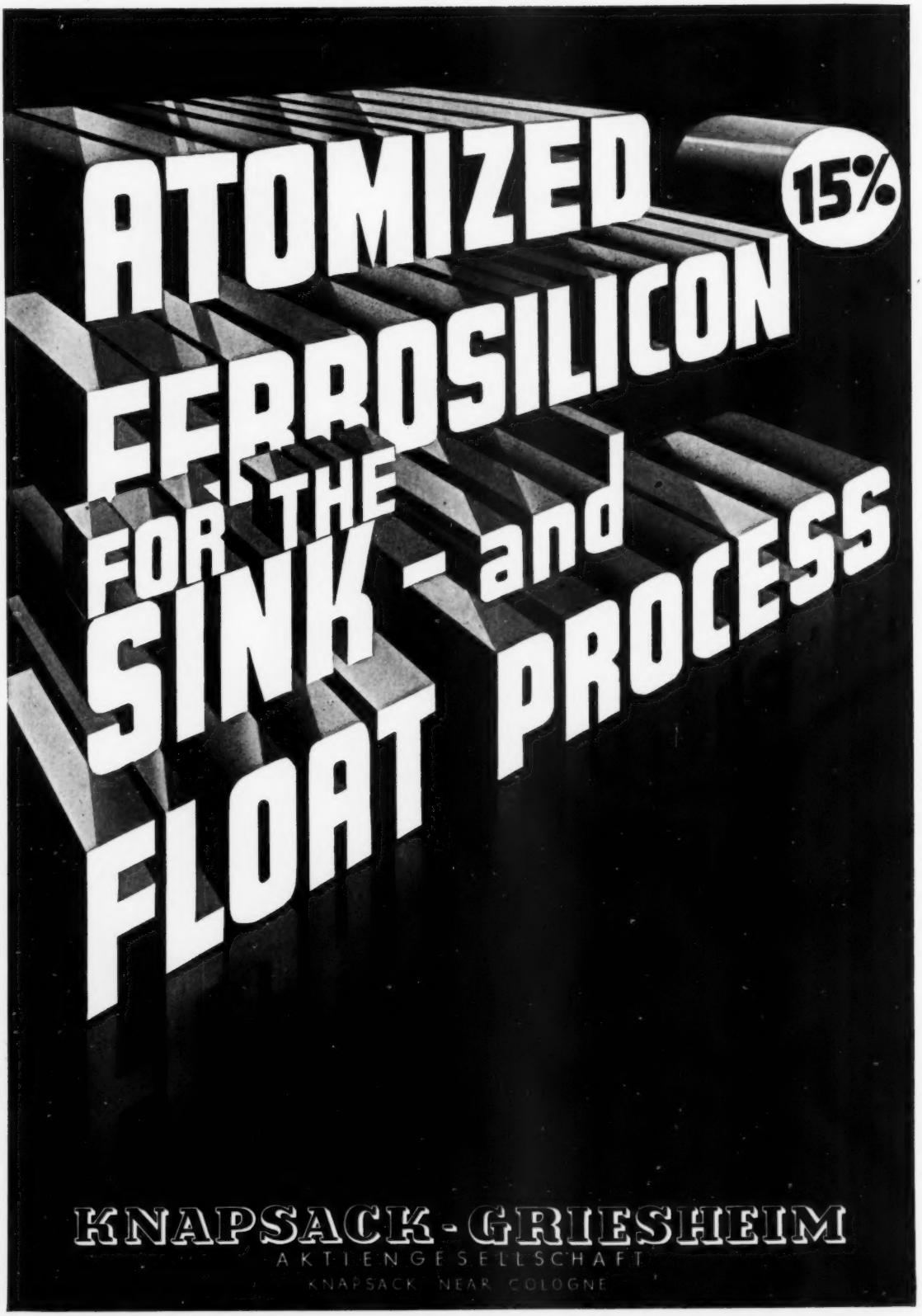
The U.S. Atomic Energy Commission, apparently, is also interested in vanadium and has claimed a process[4] for the production of the massive ductile metal. Dried, technical quality vanadium pentoxide is the starting material and is mixed with finely divided calcium and sulphur. The ratio of sulphur to oxide is 1 : 8 and the calcium is added in amount equivalent to a 60-70 per cent excess of what would be required by the equations :

$$Ca + S = CaS$$
$$5\,Ca + V_2O_5 = 5\,CaO + 2\,V$$

The reaction is carried out in a bomb, lined with magnesium oxide or a dolomitic oxide having some calcium at the base. The yield is about 83 per cent of theoretical and the metal obtained has a Rockwell B hardness of 75.

J. Glasser and C. A. Hampel of the Kennecott Copper Corporation have claimed a process[5] equally applicable to the recovery of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten and uranium in which a halide, preferably a chloride of the metal, is reduced with an alkali metal amalgam. In an example quoted, chromium chloride was introduced below the surface of a pool of sodium amalgam containing 0.9 per cent sodium. The amalgam was kept at 200 deg. C. in an atmosphere of helium, and was vigorously agitated during the addition of the chloride. The product of reaction, which contained 90 per cent of the chromium originally present, was removed from the surface of the liquid and heated to volatilize off the remaining mercury. The metals cited are not appreciably soluble in mercury and do not form compounds with it. Further, they are not appreciably soluble in the alkali metal salt produced by the reaction, provided temperature does not exceed 1,000 deg. C.

A British patent[6] describes a process for the production of magnesium, in which magnesium oxide, or a substance containing magnesium oxide, is reduced with an agent which yields only non-volatile oxidation products. The process is carried out on the surface of a slag bath heated by the passage of an electric current and analyzing SiO_2 25-30 per cent, Al_2O_3 15-20 per cent, CaO 45-50 per cent, MgO 0-5 per cent. The charge, which utilizes ferrosilicon or silicoaluminium as the reducing agent, amounts to between 10 and 18 per cent of the slag. Its actual weight is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determined by the formula: Mixture weight/molten slag weight=(T-F)/T where F is the melting point of the slag and T its operating temperature. The actual power consumption amounts to approximately 10 kW. per kilogram of magnesium per hour.

Uranium, naturally, continues to make news and the Canadian Minister of Mines and Technical Surveys has claimed a process for the production of the metal or its alloys.[7] The uranium containing compound, which may be an oxide, or may contain the uranium in the acid radical portion, is reduced with fused lithium or an alloy of lithium with sodium or potassium. Gases such as oxygen, hydrogen, nitrogen or carbon monoxide, which would also react, must be absent. Lithium oxide and excess metal, which amounts to about one-fifth of the total, are leached out with water and recovered. If an alloy is required, then the oxide of the desired alloying agent is added, in correct amount, to the original charge.

In recent years there has been an increasing interest in the rare earths. This is partly, no doubt, due to the fact that the fission products of atomic reactors are rich in these elements. This has, quite naturally, stimulated interest in the chemistry and techniques of separation. One worker who is well known in this field is F. H. Spedding and he and A. H. Daane have claimed a method[8] for the recovery of gadolinium from ores containing, in addition, samarium, europium, and ytterbium. The ore is dissolved in 6N hydrochloric acid, when a mixture of the chlorides is obtained. The chlorides are dehydrated by heating in a stream of dry hydrochloric acid gas at 400 deg. C. at a pressure of 60mm. of mercury. The chloride mixture is intimately mixed with a reducing agent which may be sodium, potassium, barium or calcium, but calcium is to be preferred and is used in 10 per cent stoichiometric excess. The charge is placed in a tantalum crucible contained in a magnesia crucible and this, in turn, is sealed into a vacuum system which is evacuated and then filled with argon. The crucible is heated inductively to 1,350-1,450 deg. C. and allowed to remain at this temperature for some time. The gadolinium chloride is reduced to metal but the other chlorides are unaffected and the gadolinium agglomerates at the bottom of the crucible. The crucible is cooled to room temperature and the chlorides and excess reducing agent are leached out with water. The metal may be finally purified by heating *in vacuo* at 1,350 deg. C.

Chemical Extractions

Selenium is of especial importance in the production of rectifiers, yet there is surprisingly little published in the literature about this element. A method of extraction has been reported by N. A. Navarro[9] in which 100 parts of Cottrell residue from pyrites roasting is heated for several hours to 180 deg. C. with a mixture of 92 parts of concentrated sulphuric acid and 12.5 parts of concentrated nitric acid. Water is added after cooling and the mixture filtered *in vacuo*. The filtrate is heated to 80 deg. C. and saturated with sulphuric dioxide. Selenium metal is precipitated and filtered off after standing for several hours.

The extraction of uranium from its ores is largely a chemical process and a number of papers have appeared on this topic during the year. Sir Christopher Hinton, of the United Kingdom Atomic Energy Authority, has published an account of the manufacture of uranium from its ores at the Springfields factory.[10] The ore is crushed and extracted with nitric and sulphuric acids. Barium nitrate is added and the radium present is co-precipitated with the barium sulphate. The uranium is first precipitated as the hydroxide and then converted to uranyl nitrate, which is extracted with ether. The uranium is then precipitated as ammonium diuranate and this is heated in a furnace in contact with hydrogen and hydrofluoric acid. Uranium tetrafluoride is formed and this is then reduced to the metal with calcium.

Huttl has described a somewhat different approach to the problem,[11] in which uranium ores averaging 0.25-0.30 per cent U_3O_8 are crushed to −10 mesh and roasted at 750 deg. C. They are then ground further to −35 mesh and leached with sulphuric acid to which sodium chlorate has been added. The liquor, which contains the uranium, is removed in thickeners and other metal sulphides precipitated with sodium sulphide. The liquor is reduced with aluminium and the uranium precipitated with sodium phosphate. Conventional methods of production may then be adopted.

Another leaching process has been claimed by G. O. Morris.[12] Pitchblende, containing about 53 per cent U_3O_8 is ground to −100 mesh. To five parts of the ore is added 13 parts of sodium bicarbonate, six parts of ammonium carbonate, 1.25 parts of potassium permanganate and 220 parts of water. The mixture is then autoclaved for four hours at 100 deg. C. and a pressure of 200 lb./sq. in. It is stated that 98 per cent of the uranium is extracted by this process.

The Canadian Minister of Mines and Technical Surveys has patented an alkaline leaching process[13] adaptable to uranium ores having a large proportion of associated carbonate minerals. The ore is ground to 85 per cent −325 mesh and leached at a dilution of three parts solution to one part solids, two parts of caustic soda being used for each part of U_3O_8 present. The pulp is heated to 100 deg. C. and agitated for 30 minutes. The solution is filtered and the filter cake reagitated for 15 minutes with an equal amount of solution. After a second filtration, the cake is washed with hot water, the final solution consisting of equal volumes of wash and leach liquors. As in the previous example, an oxidizing agent is necessary and for this purpose 8 lb. of potassium permanganate is used per ton of ore.

Exchange Resins

Ion exchange resins are becoming of increasing importance for the recovery of the rare earths, gold, the platinum metals, etc., and F. H. Burstall and co-workers have claimed a method[14] for the recovery of gold from cyanide solutions. The solution is passed through a column of Amberlite IRA-400 in the chloride form ground to between 20 and 80 mesh. The solution is passed over the ion exchange resin at a rate of 50 ml./hr./g. of the resin. The gold may then be removed from the resin by elution with a normal solution of sodium cyanide when 97.5 per cent of the gold is recovered.

P. C. Stevenson and co-workers have taken out an American patent[15] covering a method for the recovery by an ion exchange process of palladium, platinum, rhodium and iridium. The cation exchange resin used is 250 mesh Dowex 50 which is up to 16 per cent cross-linked and will retain all except the platinum, any residual traces of which may be washed through with water. The palladium is next washed through with 0.05-0.5N hydrochloric acid. The strength of the eluting acid is then raised to 2N when the rhodium passes through. Finally the iridium is eluted with 4-6N acid. The mixture of the metals is prepared for treatment by repeated evaporation with a perchloric-nitric acid mixture since the separation is only possible in the absence of halide and sulphate ions.

A Swedish patent[16] covers an ion exchange process for the extraction of uranium in the four valent state. The metal is removed from the ion exchanger by complexing with concentrated nitric acid and extraction with ether.

Fluidized Roasting Techniques

The technique of roasting ores in a fluidized bed is now being quite widely used and appears to be extremely successful. H. Kurushima and S. Tsunoda of the Dowa

Mining Company of Japan have given a detailed account of the treatment of copper-zinc concentrates by their company.[17] The Dorrco Fluo Solids system is employed and has proved extremely successful. 2,400 tonnes of zinc and copper concentrates are treated per month with recoveries of 65 per cent for zinc and 93 per cent for copper.

A process particularly applicable to the roasting of pyrites or zinc blende ores has been invented by Metallgesellschaft A.-G.[18] The ore is first of all crushed to such a size that it may be agitated by the passage of a stream of air at 0.6-1.5 metres per sec. linear velocity. The reaction chamber is in the form of an inverted cone and may be cooled by a water jacket. Cold air may also be injected.

In another method applicable to sulphide ores[19] the ore is ground to 80 per cent −65 mesh and fluidized by an air or oxygen-containing gas stream, preheated and travelling at between 1.5 and 5 ft. per sec. linear velocity. A portion of the fluidized ore is continuously being carried out of the reaction vessel at the top and is collected in a cyclone from which it is recirculated. With a recirculation ratio of 6 : 1 the sulphur content of a pyrrhotite concentrate was decreased from 36 per cent to 0.75 per cent.

New Roasting and Smelting Techniques

The new prefabricated plant at Almaden has been described by C. S. Rankin.[20] The ore here contains between 30 per cent and 40 per cent mercury and is crushed and roasted at 1,350 deg. F. The gases, which contain mercury vapour, are passed into air cooled condensers from which the mercury runs into a concrete launder where it is collected under water. The temperature of the gases at the furnace exit is 630 deg. F. and at the condenser exit never more than 115 deg. F.

Papers have again appeared on the autogenous oxygen flash smelting process of the International Nickel Company. In this process, reported in our review last year, a copper flotation concentrate and a flux are injected, with oxygen, horizontally into a specially designed reverberatory furnace, the temperature of which is maintained solely by the flash combustion of iron and sulphur in suspension. This process conserves coal to the extent of about 60,000 tons per annum and produces liquid sulphur dioxide equivalent to about 35,000 tons of sulphur. Furnaces are in operation which utilize 500 and 1,000 tons of concentrates per day.

C. W. Jensen has described the Waelz process,[21] which is used to treat materials having a low volatile metal content. The material is heated in a rotating kiln when the metal is carried away with the kiln gases, thus producing a highly enriched metal fume. If such a process is to be successfully operated, there must be a large excess of fuel in the charge, which must be moved with a trundling motion. Such a type of motion is destroyed if ferrous sulphide is present, since this has a low melting point and acts as a lubricant between the charge and the kiln lining. It is therefore important so to arrange the conditions that ferrous sulphide is not, in fact, formed.

Methods for smelting copper concentrates with high silica slags have been described by K. K. Avetisyan and coworkers.[22] The temperature of fusion of the slag rises as the silica content rises above 55 per cent and also rises as the calcium oxide content falls. If there is less than 55 per cent silica and less than 16 per cent alumina in the slag, the calcium oxide content may be raised to between 20 per cent and 25 per cent with a corresponding decrease in melting point. If the silica content of the slag is below 55 per cent and the alumina content lies between 10 per cent and 12 per cent, then up to between 10 per cent and 15 per cent

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of oxidized ore may be added to the melt. Generally speaking, the addition of oxidized ore yields slags which are either non-homogeneous or contain two layers. The smelting of concentrates which yield slags of over 55 per cent silica content may only be achieved by electrosmelting.

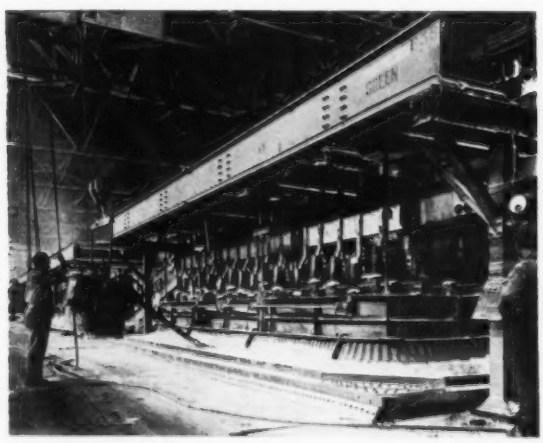
A smelting process has been described[23] in which lead may be obtained from the sulphide in a single phase. The lead sulphide is heated with carbon, the sulphide of an alkali metal, and a metallic oxide such as zinc oxide or ferrous oxide, to between 1,290 deg. and 1,470 deg. F. The lead yield is between 97 and 99 per cent and the purity of the product 99.9 per cent. Since the temperature is relatively low, there is no volatilization of the lead and the sodium sulphide may be recovered by leaching.

Attention has been focused in recent years on the avoidance of atmospheric contamination by smelters. A paper by H. F. Schwartz *et al*[24] deals with the control of atmospheric contamination during the smelting and refining of copper base alloys. The chief source of such contamination is the reverberatory furnace used for initial melting. In the processing of copper alloys, a 50 ton furnace may volatilize as much as 750 lb. of zinc per run in the form of the oxide. In order to minimize the amount of this dust, there must be, first of all, proper selection and preparation of charging material. Precautions include the proper use of the correct flux, the late introduction of high melting point scrap, and the employment of proper procedure during tapping. An adequately sized bag house is an essential for dust and fume recovery and there must be provision for shutting down at least one cell. The bag plant also serves to stabilize furnace operation by controlling draft fluctuations.

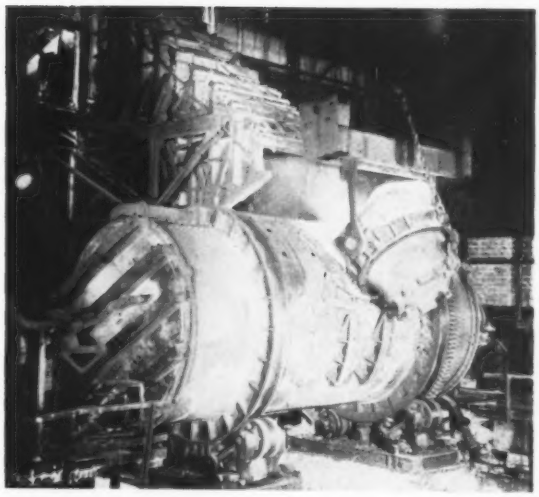
Electrolytic Methods

A very comprehensive survey of the aluminium industry has been given by T. G. Pearson, the Director of Research of the British Aluminium Co., Ltd.[25] The publication of the monograph coincided with the centenary of the launching of the aluminium industry by H. St. Claire Deville. It deals in detail with the Bayer process, the electrolytic smelting process and refining processes, and concludes with a survey of the attempts made to replace the Bayer and Hall-Héroult process. The scope of this survey can readily be seen by the fact that the bibliography contains some 334 references.

A paper on the current efficiency in aluminium electrolysis has been published by G. Szeker.[26] In order to achieve maximum current efficiency and minimum aluminium loss in the electrolysis of alumina-cryolite melts, the sodium fluoride, aluminium fluoride ratio should be 2.7 or between 2.5 and 2.6 if alkaline earth fluorides are present. The current efficiency may also be increased 1-2 per cent by the addition to the melt of five per cent calcium fluoride or 6-7 per cent by the addition of five per cent magnesium fluoride. Impurities present in the melt such as silica, ferric oxide and, more especially, titania, P_2O_5 and V_2O_5 all decreased the current efficiency and increased the aluminium loss. As the temperature of the bath is allowed to rise from 970 deg. C. to 1,090 deg. C., the current efficiency falls and the aluminium loss rises. If the electrode spacing is increased, current efficiency increases and it also increases up to a maximum with an increase in either anode or cathode current density.



Tapping aluminium by suction from a 100,000 amp. furnace
By courtesy of British Aluminium Co., Ltd.



Charging Copper Converter
By courtesy of the Copper Development Association

Campbell and Jones of the U.S. Bureau of Mines have carried out a survey of the methods for the electrodeposition of molybdenum,[27] including those in aqueous, non-aqueous and fused salt solutions. They have, rather acidly, commented that there is serious doubt about the validity of many reported claims for the electrodeposition of molybdenum and state that, in most instances, no satisfactory deposit can be obtained by the methods cited.

W. D. Gould of the Sunshine Mining Company has described the production of electrolytic antimony by this company.[28] The tetrahedrite concentrate obtained after flotation is leached at between 95 deg. C. and 100 deg. C. by a solution containing approximately 300 g. of sodium sulphide per litre. This dissolves out the antimony and leaves copper, lead and silver in the residue. The clarified liquor, which contains 60 g. of antimony per litre, is electrolysed in a cell at 2.5-3 V., with a current density of 28 amps. per sq. ft. The cell is provided with a diaphragm and the exhausted catholyte is used partly for anolyte make-up and partly in leaching fresh concentrate.

Metal Refining

Last year we referred to the technique of zone melting in the purification of germanium. L. Burris and co-workers have published a paper on the mathematics of this process and have given equations which predict the concentration profiles after successive zone passes.[29] W. G. Pfann[30] has also indicated that the zone melting technique can be used in growing single crystals, boring fine holes, small scale alloying, etc., in addition to its use in purification.

H. Welker[31] has devised a process for the purification of germanium in which nitrogen is bubbled through the

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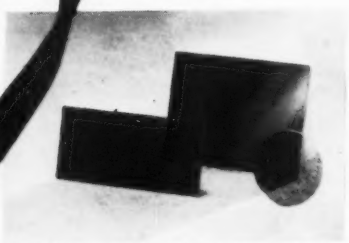

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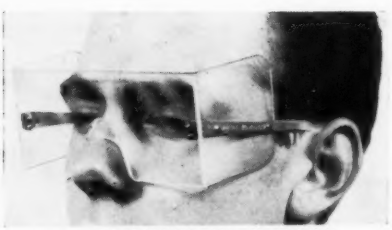

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molten metal to remove readily vaporizable impurities such as arsenic. It also serves the double purpose of distributing additives such as tin throughout the melt. The tin imparts certain desirable electrical properties to the germanium which is then quite suitable for use in diodes, electronic relays, etc.

In the refining of lead, the barrier layer of slag may inhibit the further oxidation of impurities. A method for avoiding this in which the barrier layer, together with about 5 mm. of lead, is continuously withdrawn has been claimed by Metallwerke Unterweser A.-G.[32] Removal of the oxides is carried out in an auxiliary vessel and the molten lead returned by a lead pump to the furnace.

The refining of bismuth by chlorination and distillation has been described by R. R. Rogers and R. A. Campbell.[33] The bismuth was melted in a deep graphite crucible and the chlorine led in through a graphite tube which also served as a stirring rod. A zinc chloride flux was used and the crucible was heated to approximately 420 deg. C. The flux was replaced at intervals of 3, 6 and 12 minutes and the purity of the bismuth was raised by this means to 99.91 per cent. In refining by distillation, a cylindrical steel retort containing a mild steel liner was employed. The crude bismuth was placed in a graphite container inside this liner and the pressure lowered to 0.4 μ. The purity of the bismuth obtained by this method was 95.78 per cent.

A double electrolytic process for the production of super purity aluminium has been described by E. E. Spillett,[34] which produces aluminium of 99.99 per cent purity. Aluminium made by this process is soft, has high ductility, a low rate of work hardening, and is readily worked. In addition it has excellent anodizing properties, excellent electrical and thermal conductivity and high reflectivity. Such a super purity metal may be used for cable sheathing, condensers, cladding and roofing, and similar applications.

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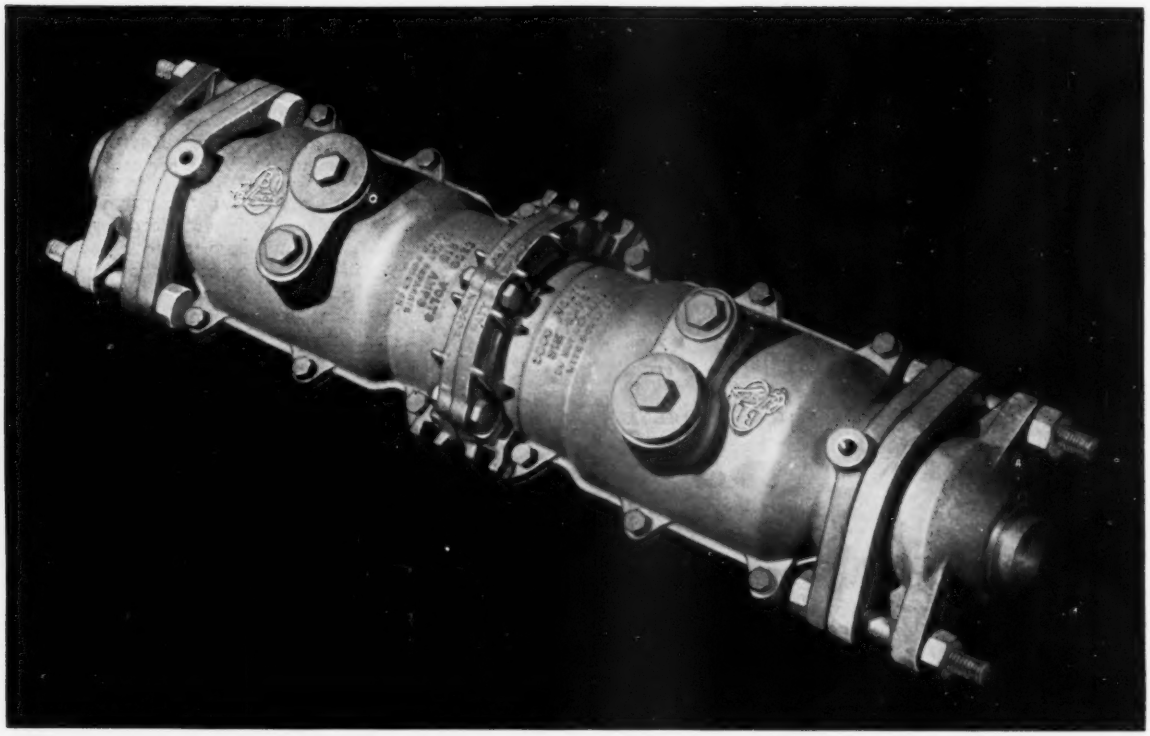

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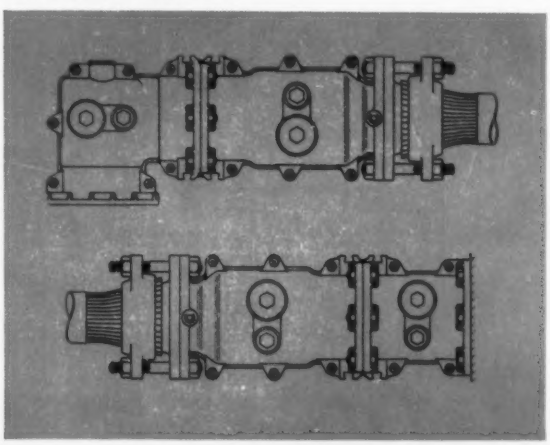

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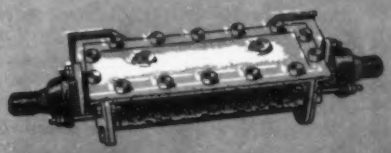

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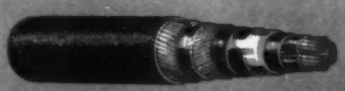

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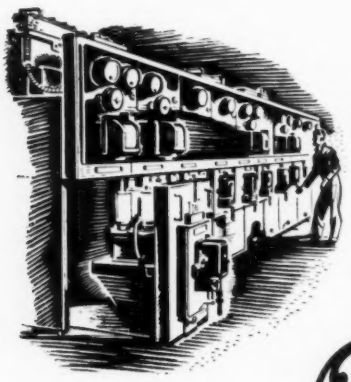

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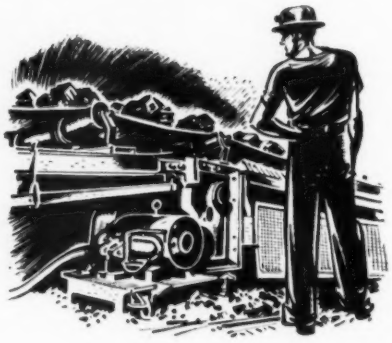

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South Africa *By Our Own Correspondent*

THE value of mineral production in the Union of South Africa continued to go ahead by leaps and bounds last year and it looks as if even greater things can be expected during 1956. The estimated total figure for 1955 is over £290,000,000, which compares with £247,500,000 for 1954 and £220,500,000 for 1953.

The major portion of this increase came from gold mining with working revenue totalling £182,745,334 from 14,601,404 oz. of gold, against £164,675,346 from 13,237,119 oz. for the previous 12 months. Exports of prescribed materials earned £29,959,589—of which about £1,000,000 can be attributed to monazite from the Anglo American property at Van Rhynsdorp — compared with £14,835,000 in 1954 and £3,873,000 in 1953. This brings the gold mining industry's direct contribution to the country's resources to around the £210,000,000 mark.

This increase in foreign exchange resources has been more welcome than ever, since, like most countries in the sterling area, South Africa found itself with a growing adverse balance-of-payments last year. Indeed, the plans to abolish import control had to be shelved and the general monetary position became much tighter. Had it not been for the contribution of the mines, the situation could be very much worse than it is at present.

THE GOLD INDUSTRY'S PROGRESS

	1954	1955
Tons milled	62,534,500	**65,950,700**
Ounces	*12,682,328	***14,093,668**
Grade (dwt.)	4.068	**4.274**
Working revenue (gold)	†*£158,630,787	†***£177,414,094**
Working revenue (per ton milled)	50s. 11d.	**53s. 10d.**
Working costs	£120,435,001	**£133,161,104**
Working costs per ton	38s. 8d.	**40s. 5d.**
Working costs per oz.	189s. 11d.	**189s. 0d.**
Est. total working profit from gold	†£38,195,786	†**£44,252,990**
Est. total working profit per ton from gold	12s. 3d.	**13s. 5d.**
Uranium and thorium exports	£14,835,344	**£29,959,589**
Uranium profits	‡£8,105,744	‡**£17,558,208**
Dividends paid	£19,127,166	**£22,361,887**

* Excludes gold produced by non-members of Chamber of Mines.
† Excludes additional revenue : 1954 £12,999 : 1955 £233,942.
‡ Subject to adjustment.

The Labour Position

The greater output of gold came entirely from the new mines of the Far West, Klerksdorp and Orange Free State areas. The older properties for the most part just held their own, being helped by some improvement in the supply of African labour and in power supplies, both of which allowed of better milling rates being maintained. 1956 started off with a distinct improvement in the flow of African labour—due largely to the poor outlook for crops throughout the country as a result of drought conditions prevailing during the two critical periods for the maize crop. It is possible, therefore, that the labour situation will be statistically better than last year and that the seasonal decline will be postponed until later in the year than usual.

Against this, however, the demand for labour by the younger mines must be expected to increase as their milling rates build up and it is to be feared that older properties will once again have to bear the brunt of the shortfall as they have to take third place to the new mines and uranium producers in the allocation of labour quotas. Paradoxically enough, the main sufferers are the efficient properties among the oldsters, since they are the most vulnerable to a decline in the labour supplies, whereas the less efficient company can make up the shortage to a fair extent by increasing efficiency slightly.

European Labour Supply Particularly Critical

The shortage of European labour—particularly artisans —is a continuing headache and there are no indications of the position improving. Recruiting endeavours go on, but, as Mr. Harry Oppenheimer pointed out recently, they are subject to the law of diminishing returns. The artisan situation is a critical one, since it is the key to the application of increased mechanization.

There have been one or two developments as the outcome of efforts to escape from this dilemma. Among developing mines, the erection and installation of certain works has been placed with construction firms in place of the old system of the work being done by the mine organization itself. This has paid off, both in time and cost. So far as producers are concerned, some experimental work is in progress whereby the maintenance work on certain equipment will be undertaken by the supply organization itself instead of in the mine workshops. This has two major advantages. First, it should guarantee a high standard of service through expert knowlege and, secondly, it gets over the inability of mines to compete in the open market for first-class artisans. It is noteworthy that this scheme is being done in co-operation with a firm of Continental origin. Local comment is that it is the Continental undertakings—Britain's strongest competitors —which are going all out on post-sales service of this nature. It may well be that this kind of thing will become the vital factor in the buying of mechanical equipment for the mines in the future.

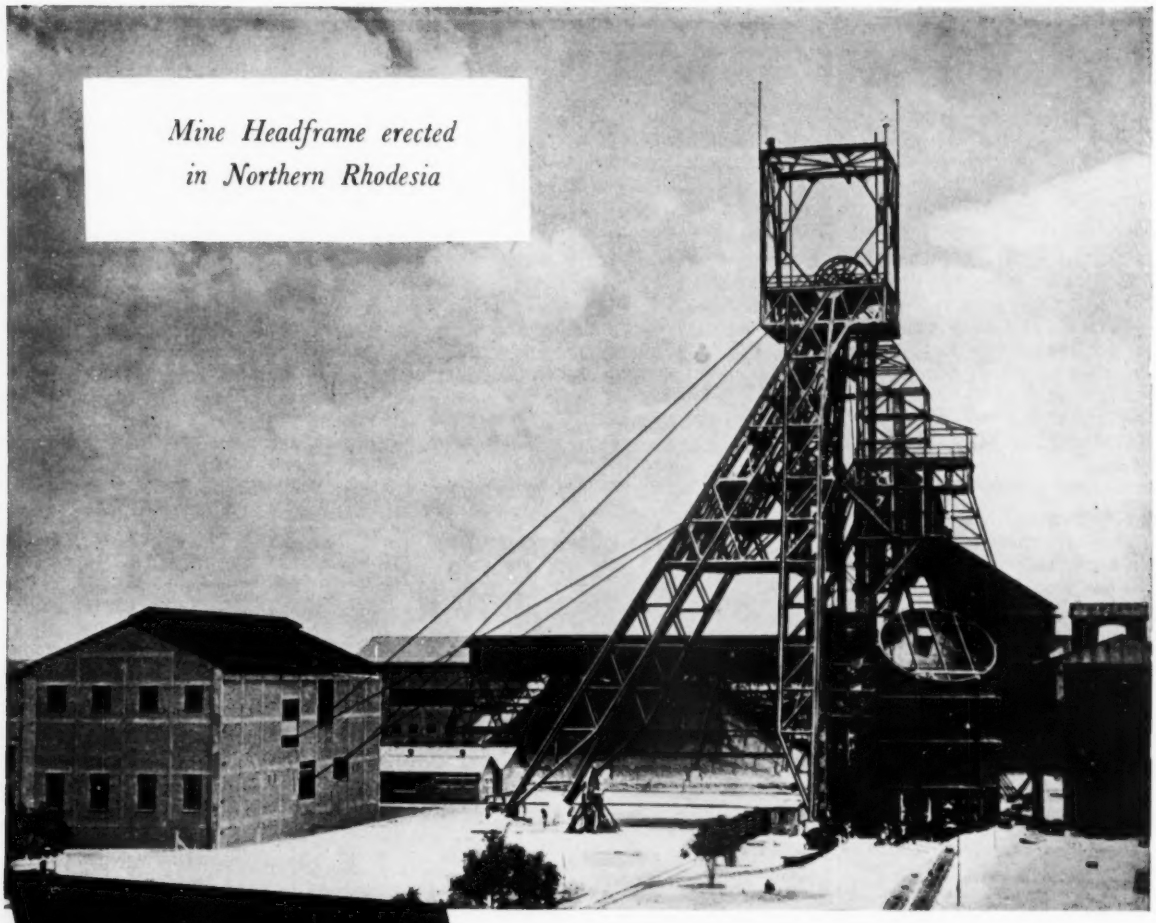
It does not seem possible to arrive at any clear picture of the exact extent of the present overall labour shortage or of future requirements. There is a disinclination in official circles to discuss the position, and there is also a growing feeling in some quarters that the approach to the problem tends to regard it as a chronic condition rather than one which could be both acute and critical.

A very large percentage of the Native labour is drawn from outside of the Union itself, and the fact must be faced that these external territories are developing fast and in time will find their indigenous supplies strained.

Greater Efficiency

Against this somewhat discouraging background, there is the silver lining of the pursuit of increased efficiency. This varies from mine to mine, but progress is being made. The main line of approach is through African training schools, both for new recruits and supervisors. At Venterpost G.M. this is being taken further with integrated training for both Africans and Europeans. Although still in the experimental stage, the results achieved so far suggest that this system has far-reaching potentialities.

Improved planning of all operations is coming into the picture and at least one group is making strides in this direction. An example of what can be done in this respect is Hartebeestfontein G.M. in the Klerksdorp district. The property was brought to the production stage in record time at a cost of around £8,000,000, in contrast with £12,000,000 and upwards for most of the other producers.



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Admittedly, this property was free of a number of the difficulties which the others have had to face—notably water trouble—but even allowing for this, it was something out of the ordinary. Now that the mine is in production the same methods of planning—basically, the maximum production of gold at the minimum cost—are being pursued with a great degree of success.

An interesting sidelight on the optimum use of manpower was the record shaft-sinking achievements at Vaal Reefs and West Rand Consolidated during last year. At Vaal Reefs, 667 ft. were sunk in 31 working days and 763 ft. in the same time at West Rand Consolidated. In recent years, records have been broken consistently using mechanical lashing, but it was apparent that the saving in time was reaching its limit, particularly in respect of smaller shafts. In these two cases, hand lashing was reverted to with highly trained teams, the length of rounds being reduced to the stage when the maximum lashing effort could be achieved, while increasing the number of rounds broken during the total period.

Klerksdorp Goes Ahead

Both last year and this are milestones in the history of Klerksdorp district. Hartebeestfontein came into production in July and the working profit built up steadily to around £145,000 a month with a milling rate of 55,000 tons. The major contributory factor to the satisfactory situation has been the application of reef-picking. (References to the adoption of this at Doornfontein were made in last year's *Review*.) Around the middle of this year the uranium plant will be brought into commission and work is going ahead with extensions to the gold reduction plant. Work has gone ahead steadily at Vaal Reefs, good development values being obtained consistently and this mine should also come into production within the next month or so. Shortly thereafter Buffelsfontein should also join the ranks of the producers and good results are anticipated from this property. Although the Vaal Reef is also the economic horizon here, it would seem that it is appreciably wider than on the adjoining properties. If this is the case, a large tonnage mine, with a capacity of around 200,000 tons a month could eventuate. The only doubt over-hanging this property is whether it will become a uranium producer, since it would appear that the Atomic Energy Board has called a halt—for the present at any rate—to the granting of loans for this purpose.

The gold output of the Klerksdorp mines last year was 954,656 oz. valued at more than £7,150,000. No figures are available but the area was one of the largest uranium producers and it may well be that it will become the leader in due course. In this connection, Dominion Reefs, South Africa's only straight uranium mine, came into production and earnings are climbing up. Some preliminary work has been done on other properties adjacent to it, but it would seem that the future prospects are obscured by the Atomic Energy Board's present reluctance to finance further undertakings.

Drilling is proceeding on the Farm Zandpan, which lies between Stilfontein, Hartebeestfontein and Vaal Reefs. On the outcome of this work depends the possibility of yet another large-scale gold mine being opened up under the technical control of Anglo-Transvaal, which was responsible for Hartebeestfontein, with Anglo American having a large financial interest. There have been no fresh developments in regard to the opening up of the area immediately south of the Vaal River, though something may happen in due course, particularly in view of the shallowness of the reef.

The one property in the area which has been somewhat disappointing has been Ellaton, where the high grade obtained at the start of operations has not been maintained, the working profit has drifted downwards for some time, and the remaining life cannot be very great.

The West Wits Line

The feature of the West Wits line has been the climbing profits of West Driefontein which now must be the richest major gold mine in the world. From 71,000 tons milled per month with a grade of more than 17 dwt., the working profit is not far short of £500,000. The uranium plant—which will also treat slimes from Doornfontein—should start up in the near future. At both these mines this will necessitate some alterations to the reduction plants, since it is intended to confine " U " extraction to the finer portions of the reef, which contains the highest uranium values. In consequence, the results of uranium earnings and the increasing milling capacities being brought into operation will not be apparent until the latter part of this year.

A major project at West Driefontein is the No. 5 shaft on the southern boundary. This will open up the deeper sections of the mine and also make available in due course the Main Reef and the Ventersdorp Contact Reefs. This shaft will be the first in the country to be equipped with Koepe winders. It is intended to install one of these subsequently at the neighbouring property of Libanon.

It had been hoped that the end of 1955 would have seen a start made with Western Ultra Deeps which lies to the south of West Driefontein and Blyvoor, but nothing has eventuated yet. An important development, however, is the scheme introduced in the South African Budget this year to allow ultra-deep mines to write off capital against tax and lease payments.

Venterspost G.M. has been doing quite well on the mining side, particularly owing to its training scheme mentioned earlier and also by tackling its water troubles by sealing off the formations above the reef by cementation. However, some disturbance has been encountered in the deeper levels to the south, and if this should prove to be the major West Rand fault it could mean the loss of a considerable amount of ground.

Some drilling has been taking place to the east of Venterspost and Libanon by Free State Development. It is understood that some encouraging values have been disclosed, but since this area is notorious for its faulting and large horizontal displacements of formations, an intensive and long-drawn out investigation is likely before any decision can be taken on whether a mine can be established.

Some drilling is still going on to the west of Doornfontein, but results are still inconclusive and there are no indications of any new mines being established in the near future.

O.F.S. Has a Patchy Year

The past year so far as the Orange Free State is concerned has been a mixed one. On the debit side it has become clear that, with working costs at their present level and little hope of an increase in the gold price in the foreseeable future, the prospects of economic operations on the Basal Reef horizon on the properties north of Free State Geduld are distinctly thin. Jeanette G.M. has been placed on a caretaking basis after considerable development had been done. At Loraine, the outlook at one time did look hopeful, but soon after production started it was found that due to errors in sampling, the ore reserve had been overvalued. At the present time, the company is running at a loss. Work is being done on the " B " Reef horizon which is showing better results, values in excess of 7,000 in. dwt. being encountered but insufficient work has been done as yet to discover the extent of these values. If this does not turn out well, then this property will have to be regarded as a marginal proposition unless a radical improvement in

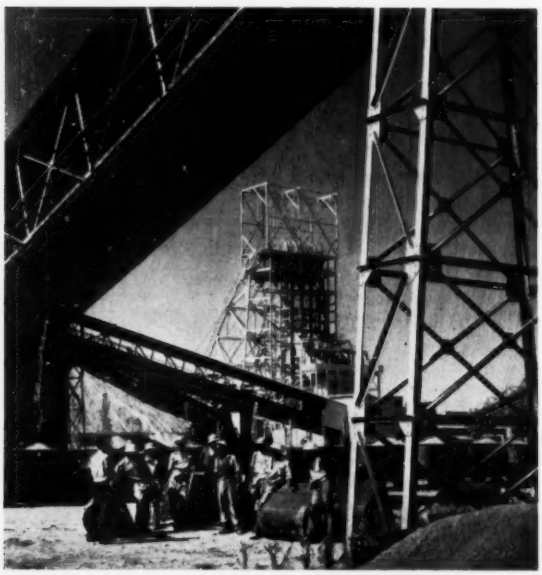
the Basal Reef mineralization is encountered. No information has been forthcoming as to whether this mine will be admitted as a uranium producer.

To the south, Freddies Consolidated has been limping along with a monthly loss of around £50,000. Work is being concentrated on exploring as much of the lease area as possible in hopes of finding better values, but there has been little of an encouraging nature to date. Unless something happens in the next month or so, it is to be feared that this property will also have to go onto a caretaking basis in the hope that an eventual increase in the gold price may bring the ore within the pay limit.

The most interesting development in the northern area is the formation of the Riebeeck G.M. Company, by Anglo-Transvaal and General Mining, to undertake underground prospecting of the Van den Heevers Rust area. It appears that a long narrow reef exists along the western boundary of the Freddies Consolidated ground at a relatively shallow depth. There is a very considerable amount of duplication of the reef which has earned it the nickname of the "Rainbow Reef". It is understood that the first development on these reefs will be accomplished by a drive from Loraine's No. 2 shaft. Depending on the results obtained a further shaft will be put down on the eastern section of the property well away from the sub-outcrop, so that no ore will be locked up in shaft pillars. Should this property be exploited, it will present some mining problems new to gold mining, in that the thickness of the reef formations together with their duplication will possibly call for something in the way of caving methods, as employed by De Beers and the copper mines of Northern Rhodesia.

More Promise in the Southern Area

All the early mines of the Free State have reached the production stage, while Saaiplaas is still in the early stages of opening up and is not expected to come into production for some years. The leading earner of working profits from gold is President Brand with over £350,000 a month from 53,000 tons of ore. Income from uranium is gradually creeping up. Slimes from this property and from President Steyn are in excess of the capacity of the latter's plant and quantities are being diverted to the plant at Welkom. In this connection, recent development at President Steyn has shown most encouraging uranium values on the Leader Reef, which may well have important consequences for this property. The major development in this area has been the start made with new shaft sinking projects. This includes a joint ventilation shaft on Welkom to serve it and the two Presidents, which consists of twin-circulars 150 ft. apart. At President Brand two sub-verticals are being put down in the No. 2 shaft area. When this programme is complete the milling rate is expected to be about 90,000 tons a month.



Free State Geduld's headgear seen through ore conveyors

The catalytic converters, part of the sulphuric acid plant at Virginia, G.M.

Apart from the ventilation aspect, the joint shaft on Welkom will allow this mine to get into the south-western section of its lease area, which drilling results suggest should contain ore of a much higher grade than that being mined at present. The work is not expected to be completed until 1959 and thus no major increase in the milling rate can be expected until then.

At Harmony, good progress is being made with the sinking of No. 2 shaft which is sited to the north of the existing workings. Judging by drilling results this will open up a richer area with an average value possibly in excess of 1,000 in. dwt. Uranium earnings here are also climbing and the recovery of pyrite to be fed to the Virginia sulphuric acid plant is being undertaken.

So far as gold recovery in concerned Virginia is still in the state of being a marginal producer, with a working profit from gold of around £30,000 a month from a grade of less than 4.5 in. dwt. a ton. The high uranium content of the reef in this area alters the picture completely however, and the combined working profit is around £130,000. Although the rated capacity of the mill is 75,000 tons a month, it is interesting to note that a throughput in excess of this is being achieved. The sulphuric acid plant at this mine is dealing with its own pyrite, as well as that from Merriespruit and Harmony. It is the main supplier to all the "U" plants in the O.F.S. and is the largest in the Southern Hemisphere. The uranium plant treats Virginia slimes and is now taking those from Merriespruit which came into production during February, 1956. An interesting development in this connection is that Merriespruit is concentrating its residues before pumping them to Virginia. This should result in a considerable saving in treatment costs and on the "U" capital expenditure.

Merriespruit created a record for new Free State mines in that it started off official production with a milling rate of 70,000 tons a month—nearly mill capacity—and returned a maiden profit of £50,000.

Production started at Free State Geduld at the begin-

ning of this year. As yet no great tonnage is being put through the mill and working profits are not great. The average grade in initial operations was below 7 dwt., but this can be expected to rise sharply once ore from the rich areas becomes available.

Bethal Comes into the Market

Shaft sinking has started at Winkelhaak, the first mine in the Bethal area, which lies to the east of the Witwatersrand. It is underlain by the Kimberley reef at relatively shallow depths, the sub-outcrop being at around 800 ft. Values on Winkelhaak itself as reflected in drilling operations are not spectacular, but it looks as if a milling grade of just over 7 dwt. could be achieved. According to the prospectus, production should be reached in about two year's time, the general view is that, all going well, it may actually be sooner. The initial milling rate will be 60,000 tons a month and will then be built up to 100,000 tons.

No details of drilling results in the rest of the area have yet been disclosed, but it is understood that they are encouraging and the suggestion has even been made that eventually there may be seven more mines.

See pages 264 to 273 for details concerning individual Rand and O.F.S. gold producers.

Diamonds and Platinum

Although the actual output of diamonds dropped slightly last year — 2,633,280 ct. against 2,891,264 in 1954. Value was nearly £1,000,000 at £13,185,946. The platinum output jumped from 338,162 oz. to 363,843 and sales were £7,098,593 compared with £6,701,144. A major expansion is under way at the Rustenburg and Union mines which will bring the annual output to around 500,000 oz. The Rustenburg mine is obtaining a large new lease area which will extend its life to somewhere around 50 to 60 years. Some investigations are being made into the northern extensions of the Merensky Reef, but there is no indication so far of mining operations being started.

BASE MINERAL SALES
(In s.tons)

	1953	1954	1955
Antimony	9,450	15,150	**22,647**
Asbestos—			
Amosite	37,294	46,177	
Blue	29,185	38,927	**124,861***
Chrysolite	17,074	17,351	
Chromite	597,493	593,955	**541,571**
Coal	30,569,655	32,313,933	**33,060,650**
Copper	37,585	49,134	**47,808**
Iron Ore	2,136,576	2,087,000	**2,210,198**
Manganese	805,574	594,517	**679,569**
Tin	1,912	2,828	**3,153**

* Details unavailable.

Base Metals

With the revival in demand, antimony and asbestos production increased last year. More than 22,600 tons of antimony sold by Consolidated Murchison realized £1,426,647 compared with 15,150 tons worth £1,014,478 in 1954. Up to the present, demand for antimony is reported to be above last year's levels, and, if it continues, 1956 will see even better results. Sales of 124,861 tons of various types of asbestos brought in over £7,000,000 compared with £5,700,000 in 1954. Some of the smaller mines started up during the asbestos boom a few years ago have gone out of existence and even if conditions improve still further it is doubtful whether they will be revived as existing producers can increase their scale of operations with little difficulty.

The tonnage of copper produced fell last year from the 1954 figure of 49,134 tons to 47,808 tons, but with the soaring price the value jumped from £9,971,000 to £13,515,000. Production this year should increase as the full effects of Messina (Tvl.) Development's expansion programme will also be felt. (See also page 279.)

Manganese companies had a somewhat more prosperous year, earning £3,455,546 against £3,095,418 in 1954. Actual production was up to 772,866 tons against 594,517 tons, but there is a continued inadequacy of railway facilities. This problem has not been resolved yet, though the current year may show some signs of improvement. Nothing concrete has developed as yet with regard to the idea of using the associated high-grade iron ore deposits in the Postmasburg area to produce ferro-manganese on the spot.

Chrome remains in much the same situation as manganese. Tonnage last year saw a drop of a little over 50,000 tons to 542,000, but sales rose from £1,984,000 to £2,259,000. The supply position, however, is somewhat more tricky. It would appear that demand is not too far in excess so that should there be a marked improvement in the railway position the price level could come down, which would undoubtedly hit some of the smaller marginal producers, who at present are making quite a comfortable living.

Coal

Coal production improved appreciably. On the output side this was due to a determined effort on the part of the Railway Administration to increase truck allocations and keep them moving. The total tonnage was 17,338,000 tons against 16,122,251 in 1954. So far as earnings were concerned, these rose from £16,122,000 to £17,338,000. This was partly due to increased sales, but in the latter part of the year an increase in the pithead price was allowed by the Government for Transvaal and Free State producers of 1s. 8d. a ton. One of the strings attached to this increase, was the Government's desire that wherever possible the proceeds should be applied to modernizations, expansion of capacity and the opening up of additional areas. In the long-run this should have good effects, since there has been growing concern for some time over the lessening gap between available supplies and potential demand—rather masked in recent years by the transport problem.

In coal the main expansion over the past year has been the coming into operation of the Sigma Colliery which will provide the coal for the SASOL oil-from-coal project. The latter, however, has been encountering unforeseen snags, so that the actual colliery is not in full-production. Incidentally, this is the most highly mechanized colliery in South Africa so far.

Iron-pyrites — Phosphate

The expansion of uranium production continues to have its effects upon the output of iron pyrites required in the manufacture of sulphuric acid which is used for leaching uranium oxide from gold mining residues. Almost all of the raw material is derived from the gold uranium ores. Last year some 391,000 tons were produced, compared with 253,000 in 1954, valued at £1,100,000 against £658,000.

A big jump was recorded in phosphate production, largely as a result of operations at FOSKOR, the State-owned project at Letaba in the north-eastern Transvaal. Total output for the country last year was 128,391 tons against 104,169 tons in 1954 and the value rose from £57,681 to £113,998.

In general, the outlook for the curent year is encouraging. It is estimated that the value of gold production will rise to around the £195,000,000 mark as the young producers steadily build up their capacity and as yet more new properties reach the production stage. Uranium production is still below its maximum potential and the conservative view is that it should top the £36,000,000 mark at least. Further progress by other mining undertakings is apparent at present and, all going well they could bring in £90,000,000 this year. Adding all these up, the total figure for 1956 may well be in excess of £320,000,000.

South West Africa

THE feature of mining in this territory over the past year has been the expansion of activities at the Tsumeb mine and the steady progress at the Consolidated Diamond Mines. Outside of these two, the tempo of both mining and exploratory work has been of a lower order, and it looks as if the high hopes of a year or so back have not been fulfilled.

At Tsumeb, the production of lead-copper-zinc concentrates rose sharply. In terms of metal content over 23,500 tons were produced against 15,700 in 1954; lead 83,700 tons against 77,000, and zinc 23,229 tons against 22,000. The total value of the combined output is estimated at getting on for £12,000,000 a year. According to reports, the further opening up of the mine is disclosing most encouraging mineralization.

S.A. Minerals continues to be the one major manganese concern in South West, but the position there seems to be rather obscure. Production during 1955 was well up on 1954 (42,000 tons compared with 31,000), but sales declined from 31,000 to 30,000 tons and from £282,000 to £270,000.

In spite of all efforts it does not look as if much progress has been achieved in putting the Uis Tin Mine on an economic footing. Tin production at 367 tons was below the 455 figure of the previous year, although sales were better at 372 tons realizing £136,000.

Wolfram production has been at a slightly better level—around 121 tons—but here also there seems to have been little success with the marketing. On the production side, the greatest promise seems to be in the success achieved by the South West Africa Company's mine at Brandberg West where scheelite production last year started on a small scale. Additional rock-handling equipment is being installed.

The output of vanadium from Abenab West mine showed little change over the year, but it is understood that transport difficulties prevented this company taking advantage of the improvement in demand.

Consolidated Diamond Mines celebrates its 35th anniversary this year. No fresh production figures are available since 1954, but it is common knowledge that these continue to increase with extensions to the treatment plant. So far as is known, there are no signs of this deposit petering out.

BASE MINERAL PRODUCTION
(in s.tons)

	1954	1955
Beryl	564	**471.5**
*Cadmium (in zinc concentrates)	810	**701**†
*Copper (in copper-lead concentrates)	15,668	**23,561**
Fluorspar	3,060	**675**
*Lead (in lead concentrates)	77,146	**83,716**
Lithium—		
Amblygonite 6% - 8% LiO_2	1,174	**1,414**
Lepidolite 3% - 3.6% LiO_2	4,178	**1,832**
Petalite 3% - 4% LiO_2	1,835	**5,278**
Manganese (48% ore)	34,066	**41,880**
Phosphate (guano)	908	**1,944**
Salt	52,196	**64,757**
*Tantalite/Columbite	13	**6.1**
*Tin (in tin and tin-tungsten conc.)	499	**399**
*Tungsten (in wolframite)	101.1	**121.7**
*Vanadium (in lead-vanadium conc.)	1,130	**1,021**
*Zinc (in ores and concentrates)	22,032	**23,229**

* Expressed in metal content. † Exports.

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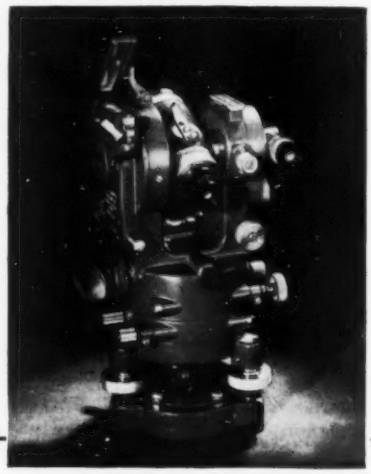

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The Central African Federation

THE past year has been one of progress on most of the important issues facing the nascent Central African Federation. Thus African advancement on the Copperbelt, which is of vital importance to the realization of the partnership ideal and the long-term success of the Federation, has taken a real step forward, while past territorial rivalries regarding the Kariba-Kafue hydro-electric issue have been buried in the common determination to press on with all speed on the larger Kariba project. The railway position is, of course, still unsatisfactory but here too some progress has been made.

The review which follows should be read in conjunction with the articles on pages 279 - 289.

Tremendous Prospecting Activity

In both Northern and Southern Rhodesia the year has been notable for a tremendous surge of prospecting activity. The financial climate for such activity has, of course, been favourable in consequence of current high metal prices—notably for copper—coupled with the high level of taxation on profits. Since the beginning of 1955, no fewer than five major prospecting companies have been established.

Of these, Rhodesian Selection Trust Exploration Limited is concerned with the search for minerals throughout the Federation (other than the Copperbelt area itself), while others concerned exclusively with prospecting in Northern Rhodesia are Chartered Exploration Ltd. (an Anglo American venture in which Chartered and Consolidated Goldfields are also interested), which has prospecting rights over about 100,000 sq. miles; Rio Tinto Finance and Exploration Ltd. (in which Rhodesia Katanga and Tanganyika Holdings both have substantial interests), which has exploration rights over 2,500 sq. miles, including certain copper areas mentioned later in this article; and New Consolidated Prospecting (Pty.) Ltd., in which the Consolidated Goldfields and R.S.T. groups are jointly concerned in exploring the Mwinilunga copper concessions. Concerned solely with exploration in Southern Rhodesia and Nyasaland is Anglo American Rhodesian Mineral Exploration Ltd.

Prospecting for diamonds has begun in the Kanona area of Northern Rhodesia and De Beers Consolidated Mines Ltd., have opened on office in Broken Hill. An agreement under negotiation between De Beers and the Government of Northern Rhodesia provides for the surrender of the company's exclusive prospecting and mining rights in 1986.

Aside from these newly established prospecting ventures, the search for minerals has been energetically prosecuted by a considerable list of established concerns, as will become apparent.

It is noteworthy that five applications for permits to carry out airborne prospecting with magnetometer and scintillometer equipment, were dealt with by the Central African Air Authority. It is believed that the Hunting group will shortly establish a geophysical service, with a fully equipped aircraft, for use in the Federation.

Copperbelt Production

Copper production in Northern Rhodesia fell during 1955 to 354,000 tons compared with 392,000 tons in 1954. Production would actually have increased had it not been for an eight-week strike of African workers at the beginning of the year which lost the industry some 50,000 tons. Given a strike-free year, 1956 is likely to see production up to well over 400,000 tons, aided in part by expanding production at Mufulira and in part by Chibuluma where the concentrator was due to come into operation at the beginning of May, 1956.

Looking further ahead, Bancroft is scheduled to come into production at the beginning of 1957 with an output of 42,800 tons, a figure which is expected to be doubled by 1960. Meanwhile de-watering and equipping of the Kansanshi mine is in progress and production should start towards the end of 1956. Mufulira is expected to double its refinery capacity to 72,000 tons in the course of this year, while at the same time raising mill throughput from 285,000 to 340,000 tons of ore. Roan Antelope's Ndola refinery is scheduled to come into production in 1958, with an initial capacity of 55,000 tons to be doubled by 1960.

Production of cobalt on the Copperbelt has received a boost with the bringing into production of Chibuluma which is expected at full production to have an output of 500,000 lb. of cobalt in addition to 16,000 tons of copper on a mill throughput of 480,000 tons of copper/cobalt ore. The cobalt treatment plant is expected to be in operation at the end of this year.

The Search for New Deposits

The Rhodesia Selection Trust group have a number of other possible mines in prospect, although no date has been set for bringing them into production. Of these Baluba (which is situated 40 miles to the South of Mufulira) and Chambishi (some 20 miles south-west of Mufulira) are the most fully explored and are both potentially large mines. Baluba may incidentally prove to be the largest cobalt deposit in the world.

In addition, roughly the whole area west of the Kitwe-Bancroft road right through to the Angola frontier is under option to mines in which R.S.T. are primarily concerned. The first area, as far as longitude 27 east, is being prospected by Chisangwa Mines Ltd. (in which Rhodesian Anglo American are also interested through Rhokana). Small portions of this area are also being prospected by the main producing mines on the Copperbelt. Beyond this is an area extending west to the Angola frontier and north to the Congo border, which is held under prospecting licence by Mwinilunga Mines Ltd., and is being explored by the New Consolidated Prospecting Co. (Pty.) Ltd. while about 30 miles due south of Kitwe a further area is held by Kadola Mines Ltd. Finally a strip nearly 200 miles long running along the Congo border northwards from the Pedicle is under option to Luapula Mines Ltd., while to the north of this concession Weedons Minerals are investigating a known copper occurrence at the north-eastern corner of Lake Mweru. Other areas between Chisangwa and Kadola, and again between Kadola and the Congo frontier at the south of the Pedicle, are held by Rio Tinto and will presumably be among the principal areas to be explored by Rio Tinto Finance and Exploration Co.

Thus virtually the whole Belgian Congo common frontier with Northern Rhodesia (except for the northern and eastern extremities of the Pedicle) is being either mined or prospected for copper by one or other of the big groups.

Copperbelt Labour Relations

Probably the most important development on the Copperbelt during the year, for the industry no less than for the future of the Federation, was the evidence of a new spirit of co-operation between the European Mineworkers and the Chamber of Mines on the issue of African advancement. The net result of what have been extremely prolonged, and at times most unpromising, negotiations has

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N. RHODESIAN MINERAL OUTPUT

(in tons)

	1952	1953	1954	**1955**
Cobalt alloy	1,249	1,087	1,063	**373**
Cobalt metal	39	394	588	**410**
Cobalt (other)	2	46	167	**287**
Copper (blister)	200,799	210,061	204,975	**165,000**
Copper (concentrates)	5,513	226	1,064	**2,973**
Copper (electrolytic)	111,555	152,520	173,636	**177,000**
Iron ore	5,943	2,169	961	**2,164**
Lead	12,600	11,510	15,000	**19,544**
Limestone	272,094	231,577	287,139	**304,590**
Manganese ore	3,926	7,129	16,754	**17,331**
Mica (sheet)	17	7	2.8	**2.5**
Zinc	22,890	25,330	26,550	**28,000**

been an agreement between the Chamber and the European mineworkers whereby 75 new categories of jobs are to be made the exclusive preserve of Africans. Twenty-four of these categories represent jobs which were previously performed by Europeans exclusively or else were in the "ragged edge" category of jobs open to both Africans and Europeans. The remaining 51 categories involve the advancement of Africans into newly created jobs outside the European sphere. It is expected that by the middle of this year some 500 Africans will either be in advanced jobs or be undergoing training for such jobs, and eventually about 1,000 Africans are expected to secure advancement to one or other of the 75 categories. The agreement provides that no further steps in African advancement shall be taken for three years and in the meantime a firm of management consultants is to be retained jointly by the Chamber and the Union to complete a detailed job-analysis of all mine duties as a factual basis upon which further discussions on advancement may, in due course, proceed.

Since this agreement was reached, the African Mineworkers' Union, which was not a party to the agreement and which, in any case, is inclined to be more interested in advancing the general level of African earnings than in differentials for a small minority of its members, has recently been opposing the advancement proposals, mainly on the grounds that the wage difference between maximum African earnings in new categories and lowest European earnings is too great. The European Mineworkers, on the other hand, have been tending to take the line that so long as Europeans continue to have difficulty in finding fresh employment on the Copperbelt, they will be unwilling to consider further advancement proposals. This attitude conveniently overlooks the fact that, with the copper bonus at about 100 per cent, a surplus of Europeans seeking employment is bound to occur. However, in view of the concessions to which the Union have already agreed in order to make possible the first step in African advancement, it would be unwarranted pessimism to suggest at this stage that realism will not carry the day when further advancement proposals come to be considered.

Other Northern Rhodesian Ventures

Thirty-five miles to the south-west of Lusaka, the Anglo American Corporation, after several years of investigation, are now seriously considering exploiting the King Edward copper mine. It is at present proposed that only the minimum of surface plant should be erected on the site, and that refining should be done mainly on the Copperbelt.

In the Fort Rosebery District, across the Congo Pedicle, an American concern, the Rhodesia Vanadium Corporation, have bought from Weedons Minerals a 200 sq. mile manganese propect and have already spent considerable capital on development. Manganese is being mined by opencast methods—it occurs only close to the surface—and big development now awaits the completion of the rolling mill and the arrival of heavy earth-moving machinery.

There are known to be other occurrences of manganese ore throughout the Luapula area, where Rhodesian Selection Trust prospecting teams have for some time been at work.

Gypsum Industries are developing manganese at Chiwefwe on the Great North Road and at Kamapumba on the Broken Hill-Mulungushi road; while Magundi Copper Mines and Minerals Co. are pumping water out of all the workings at Mtuga Copper Mine—an interesting prospect since copper occurs here in granite formations. It is, however, in consequence extremely patchy.

During the year, Magundi Copper Mines and Minerals Ltd. also took over 10,000 sq. miles under option from the North Charterland Exploration Company along the common frontier of Portuguese East Africa and Northern Rhodesia. Prospecting is in progress.

What may prove to be one of the more promising discoveries outside of the Copperbelt is that made by the Government Geological Survey of the pyrochlore deposits at Nkombwa Hill in the Isoka district of the Northern Province. This is about 400 miles from the nearest railhead, not far from the northern end of the Nyasaland boundary.

The pyrochlore deposits on Chilwa Island, situated in one of the lesser known of Nyasaland's four lakes, have come into the news lately. Their extent has not been disclosed, but a mining company has been endeavouring to prove the deposits during the last two years and it can be said that Chilwa may provide strong competition for other pyrochlore-bearing areas in Africa.

A new company, Choma Mines Ltd., with a modest nominal capital of £100, has been registered in Northern Rhodesia for the purpose of acquiring certain tin claims in the Choma district. It will become a subsidiary of Rhodesian Selection Trust. Tin has been mined in the Choma district for some years on a very small scale.

Southern Rhodesia has a Record Year

Southern Rhodesia's mineral output showed an increase on the year of almost £2,000,000 in value and reached a record of £20,500,000, thus reversing the downward trend in 1954. The principal increments were in respect of asbestos (£1,500,000) and copper (£250,000). Were it not for the continued short railings of chrome, this mineral could have added a further £1,000,000 to the total.

The following are some of the highlights of the year.

Gold. In an effort to assist production, small development loans were made available to three applicants during the year, on the new basis whereby the Government stands 50 per cent of the risk. In all, four loans were granted (one for lithium) totalling £6,800. The number of small workers continued to decrease, but there are many pro-

S. RHODESIAN MINERAL OUTPUT

(in tons)

	1952	1953	1954	**1955**
Arsenic	568	416	458	**507**
Asbestos	84,834	87,739	79,922	**105,261**
Beryllium ore	1,186	1,774	1,077	**963**
Chromite	861,839	463,030	442,509	**449,205**
Coal (raised)	2,821,221	2,886,443	3,029,329	**3,653,801**
Copper	120	211	298	**1,178**
Corundum	—	843	2,840	**11,609**
Iron ore	71,465	69,478	70,885	**92,835**
Iron pyrites	21,002	40,417	40,783	**23,282**
Lithium Minerals				
Amblygonite (conc.)	—	336	434	**180**
Lepidolite	—	7,682	26,909	**57,713**
Petalite	—	11,580	26,707	**24,209**
Limestone	435,033	460,369	601,974	**663,530**
Magnesite	12,073	10,824	7,742	**11,609**
Mica (block and waste)	747	155	83	**64**
Tungsten (conc.)	430	388	259	**226**

perties persevering despite book losses. Three of the larger, low grade, mines have also been promised financial assistance, though the particulars have not yet been made public. The Cam and Motor continues to show good profits, while the re-discovery of the slate reef on the eighth level of the Arcturus mine was most welcome news. The reduction plant is to be increased to mill 6,000 tons per month.

Asbestos. The production from the new Johns-Manville Temeraire mill increased month by month to 1,200 tons at the year end, and constituted the principal increase in the output figures.

Copper. The Messina Transvaal Development Company's "Umkondo" property in the Sabi Valley came into production in May. Concentrates with an average assay of 33 per cent copper are road hauled 300 miles across the Limpopo River for smelting at Messina. The production rate is now 2,000 tons per annum. Much greater tonnages will be smelted when the same company's Mollie mine starts in 1959, under the name of M.T.D. (Mangula) Ltd. Results indicate that minimum ore reserves are in the region of 16,000,000 tons, containing 256,000 tons of copper.

Now that a copper smelter is operating in the country again (there has been none since the Falcon mine ceased operations 30 years ago) it is likely that several small properties will re-open on selected ore.

Sebungwe Mines and Exploration Ltd., announced recently that it was withdrawing from the Copper Queen and Copper King mines after having spent more than £200,000 on geological and geophysical work, including an extensive drilling programme. The owners of the Copper Queen and Copper King claims have stated that they will probably work the mines themselves.

Uranium. The sale of electronic prospecting equipment is reputed to be considerable, but to date there have been no noteworthy finds. At the year end the United Kingdom Atomic Energy Authority set up an office in Salisbury to stimulate interest in the search for nuclear minerals throughout the country.

Nickel. A disseminated nickel-bearing pyrrhotite occurrence in the Ngondoma area was registered and offered to various mining groups. Minerals Search of Africa Ltd. (a Rio Tinto subsidiary) are at present carrying out a diamond drilling programme, in an exclusive prospecting reservation of 95 sq. miles.

Tin. Kamativi Smelting and Refining Company, a subsidiary of the Dutch Billiton group, commenced production of pure ingot at the rate of 35 tons per month. Solder is being made with refined lead from Broken Hill. The company's capital has now been increased from £700,000 to £3,000,000 with the object of increasing the milling rate to 1,000 tons/day.

Iron. The Messina Company is holding the Bukwe hill of iron ore on the new rail link to Lourenco Marques. Indicated ore totals 120,000,000 tons. Meanwhile negotiations for the purchase of the RISCOM Iron Works at Que Que continue. It is not known what progress has been made in the iron and coal reservation held by the Sabi Mining and Exploration Co. (a subsidiary of Anglo Transvaal Investment Co.).

Coal. A portion of the Wankie coal lease area, acquired by the Territorial government is being drilled by Messina with a view to the working of their Bukwe iron ore deposits; and Lubimbi Coal Areas Ltd. continue to search on the Gwaai River. In this latter connection a preliminary investigation is being made into the possibilities of producing oil from coal from the Lubimbi coalfield, near Wankie, and of setting up a large-scale petrol producing industry and allied chemical industries. Rhodesian Anglo American Ltd. and Wankie Colliery Ltd., equal shareholders in Lubimbi Coal Areas Ltd., are behind the project. The estimated reserves at Lubimbi exceed 80,000,000 tons, and proved reserves would support an oil from coal industry using 1,600,000 tons a year for 50 years.

Lithium. The Fort Victoria district produced nearly all the lithium ore mined in Southern Rhodesia in 1955. Only 2,000 tons of the 82,000 tons came from other parts of the country. The ore was valued at £328,442. Fort Victoria ranks as one of the world's most important areas for the supply of lithium minerals. A development programme of over £1,000,000 has been started by Bikita Minerals to step up their production to 90,000 tons. Rail availability would greatly assist the progress of this industry, and representations have been made for a link between Fort Victoria, Bikita and the Eastern Districts.

Corundum. The deposits of massive corundum in the Concession district are being worked (using flame piercing) to supply limited demands from a South African refractories company, which operates the mine.

Chrome. Flotation methods inaugurated at the Feoch mine having proved successful, other companies are installing similar plant to concentrate fine chrome from eluvial and decomposed serpentine.

In the lower Zambesi Valley, a hitherto unmapped ultra basic dyke was discovered during the year. An airborne magnetometer survey has revealed interesting anomalies and a field party is preparing to go into this most inaccessible and inhospitable country.

Power and Transport in the Federation

The development of the Federation as a whole, and expansion in the Copperbelt in particular, continues to be bedevilled by coal shortages due to inadequate rail facilities. The Copperbelt's normal monthly needs are 90,000 tons of coal, but only some 70,000 tons has been reaching it from Wankie. The balance has been made up by wood and oil burning and, since February, by costly imports of coal from the United States through Lobito Bay, the West Coast port in Portuguese Angola. Over the past few years copper production has often been curtailed and has occasionally been suspended on some mines as the result of coal shortage.

Until the Kariba hydro-electric scheme comes into operation in 1960, the whole of the large expansion programme on the Copperbelt is dependent on the maintenance of coal supplies, supplemented as from next year by additional power supplies from the Le Marinel power station on the Lualaba River in the Congo. Incidentally, it is of paramount importance that Kariba should be completed on time, since the Belgians will themselves require this surplus output from Le Marinel as from 1961.

Meanwhile, Wankie has more than made good the arrears of a few years ago in its expansion programme, and this year will reach an annual output capacity of 5,000,000 tons against a current railing capacity of about 3,500,000 tons per annum. In view of this transport bottleneck, some interest attaches to the potentialities of the coalfield which have been investigated in the Kandabwe areas near Choma. Whether or not this coalfield is ever exploited may well depend on the prospects of obtaining power for the Copperbelt from other sources before 1960.

The tremendous rate of the Federation's development has tended to obscure the progress being made by the railways and to accentuate their failings. Nevertheless, great progress has been, and is being, made. The carrying capacity has been considerably increased by heavy importations of rolling stock, a substantial amount of which (some £6,000,000 worth out of a total of £40,000,000) has been loaned by Anglo American, mostly through the Anglo American Rhodesian Development Corporation. Until quite recently there have been long delays in the delivery of rolling stock and equipment from overseas manufacturers, and orders are only now beginning to catch up.

On August 1, a new line to Lourenco Marques in Mocambique, the Portuguese territory, was opened to goods traffic, while, all being well, passenger services are expected to start next July.

Growing pressure is being brought to bear upon the Governments of the Federation to encourage the processing of minerals within the country. Railway bottlenecks and high freight charges are at present the two biggest obstacles to a more intensive development of a base mineral industry.

Several rail links are still urgently needed, and the Federal Government has given top priority to a direct line between Salisbury and the Copperbelt. It would bring the Copperbelt 527 miles nearer the east coast port of Beira, and would bridge the Zambesi probably a short way downstream from Kariba, with considerable benefit to the hydroelectric scheme.

Rapid progress with this Kariba scheme is all-important, not only because of the Copperbelt power requirements after 1960, but also because the substitution of hydroelectric power for generation from coal would greatly ease the strain on railway goods traffic.

In 1954 the area of the Federation of the Rhodesias and Nyasaland to be supplied by Kariba was consuming about 1,800,000,000 kWh. of electricity. It was estimated that by 1960 the demand would have risen to 3,200,000,000 kWh. and by 1970 to 7,200,000,000 kWh.

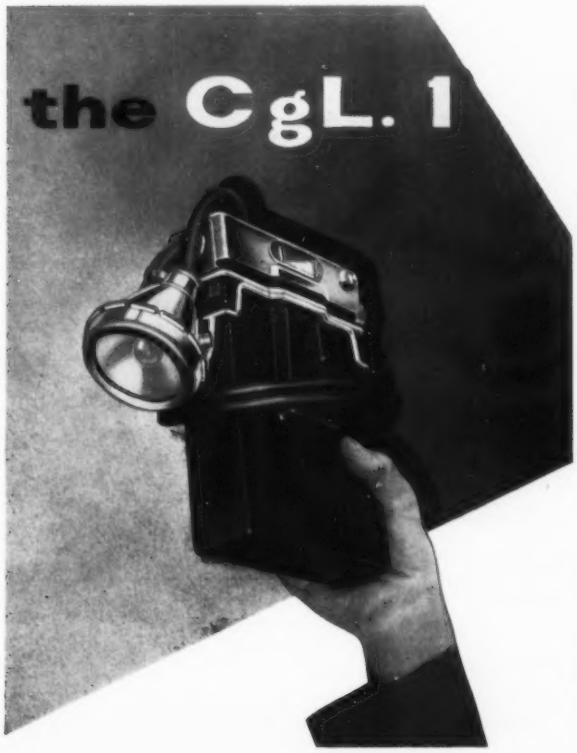
The scheme is in two parts. The first calls for construction of the dam wall, a diversion tunnel and the installation, in underground power stations, of six sets of turbines and generators, each developing 100 megawatts. Another similar power house would bring the total capacity of the scheme up to 1,200 megawatts—ten times the production of the biggest thermal station at present in operation.

Finance for Rhodesian Development

Finance for the development of the Federation in its present phase of dynamic expansion is a major problem. The Northern Rhodesian territorial government may understandably view with mixed feelings the large contribution which its mining industry is making to the Federal exchequer, where formerly this revenue would have been available for purely territorial development. Nevertheless, it is the dynamic of the Copperbelt which is providing a great deal of the finance on a wide range of Federal development programmes.

This has been entirely thanks to the farsightedness of the Copperbelt companies, which Mr. Prain has described as a sense of responsibility to the community, and which Mr. Harry Oppenheimer has described as enlightened self-interest. Whatever the motivation, the copper companies, for which these men speak, are clearly determined to ensure that the Copperbelt should not be allowed to develop at the expense of the rest of the Federation. Thus the Copperbelt companies, with Chartered, are finding nearly half the finance for the initial stage of the Kariba scheme costing £79,000,000. Again the establishment by Anglo American of the Anglo American Rhodesian Development Corporation has already brought material assistance to the railways, while the Rhodesian Selection Trust is financing schemes for rural development in Northern Rhodesia and Nyasaland, and possibly, if present investigations warrant it the Kafue Flats scheme, whereby considerable tracts of arable land may be reclaimed on the banks of the Zambesi above the Kafue Gorge.

These contributions by the mining companies are all, in their various ways, ensuring that the economy shall advance on a much more balanced basis than was, for example, the case in the early decades of the industrialization of the Union of South Africa.



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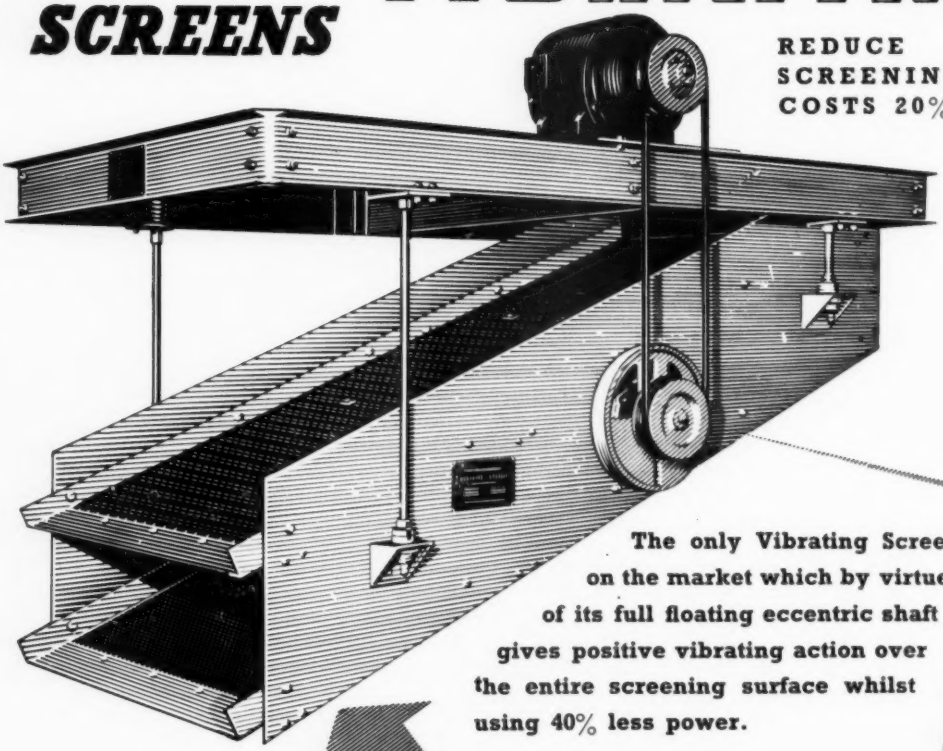

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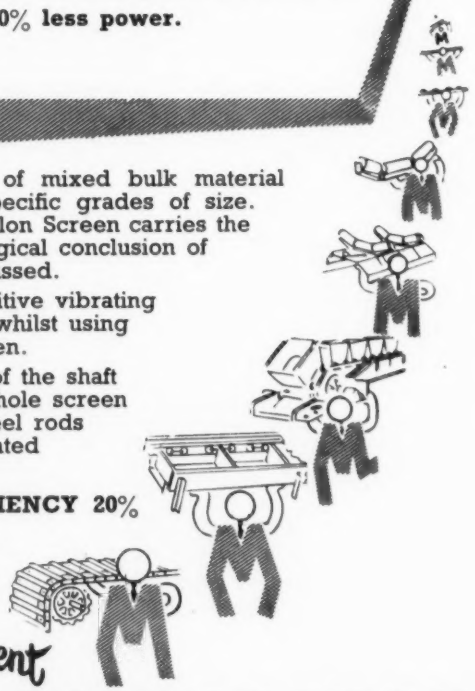

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East Africa

By JACK SPALDING, A.R.S.M., B.Sc., M.I.M.M.

DURING 1955 there was a considerable revival of interest in prospecting in East Africa. The Anglo American Corporation of South Africa Limited set up an office in Tabora, Tanganyika, and have made a number of reconnaissance traverses with an airborne scintillometer and a magnetometer. It is understood that these are preliminary to exploratory work on a much larger scale.

Mr. H. Vogt, a private prospector from Southern Rhodesia, also made airborne scintillometer surveys over selected areas in the Southern Highlands of Tanganyika, as a result of which he has applied for exclusive prospecting licences over 25 sq. miles in the Mbeya District. Another airborne scintillometer survey has been started by Williamson Diamonds Ltd.

Stimulated by the possible demands for power to exploit the Mbeya pyrochlore deposits, the Colonial Development Corporation have begun an investigation of the Kiwira-Songwe coalfields at the head of Lake Nyasa. Should a coal mine be established on that field, there is a good chance that coal could be offered to the Nyasaland Railways at a competitive price, via Lake Nyasa.

In Uganda, Unicorn Mines Ltd., a subsidiary of Union Corporation Ltd., continued their prospecting programme and pegged two exclusive prospecting licences in the bismuth area of the Kigesi District. A number of gozzan outcrops are at present being tested.

In Kenya a subsidiary of the Anglo American Corporation of South Africa Limited were granted a special licence of about one square mile, covering Mrima Hill, a mineralized carbonatite deposit known to contain niobium in association with rare earths.

On the mining side the chief item of news was the starting up of the production plant of the Mpanda Mine of Uruwira Minerals Ltd. in Tanganyika. This took place, according to schedule, in May. This is the first time that long-hole drilling and full mechanization have been introduced into East Africa.

One or two small producers have closed down or appear to be likely to do so in the near future, but their place will be more than filled by new and larger mines.

MINERAL PRODUCTION

		1954	1955
Tanganyika			
Coal	tons	522	*785
Diamonds	ct.	329,912	*322,661
*Gold (refined)	oz.	71,447	*68,892
Raw gypsum	tons	4,440	8,223
Lead concentrates	tons	4,694	8,822
Magnesite	tons	78	328
Mica sheet	tons	78	65
Mica waste	tons	28	274
Salt	tons	21,612	25,670
*Silver (refined)	oz.	42,205	43,292
Tin concentrates	tons	54	55
Tungsten concentrates	tons	12	24
Kenya			
Carbon dioxide gas	tons	582	636
Diatomite	tons	3,258	2,950
Gold (refined)	oz.	6,607	9,258
Graphite	tons	310	*216
Gypsum	tons	503	851
Kaolin	tons	—	919
Mullite and Kyanite	tons	4,018	2,706
Salt	tons	18,795	25,376
Silver	oz.	1,325	1,170
Soda ash	tons	96,074	124,744
Vermiculite	tons	720	340
Uganda			
Beryl	tons	29	138
Lead concentrates	tons	68	73
Gold	oz.	568	450
Phosphates	tons	2,867	3,105
Salt	tons	—	9,009
Tantalite/Columbite concentrates	tons	13	15
Tin concentrates	tons	119	96
Tungsten concentrates	tons	168	136

* Excludes gold and silver in lead concentrates.
* Provisional estimate.

TANGANYIKA

Tanganyika's mineral production broke a new record in 1955 with a value of just under £5,500,000. This compares with the previous record in 1954 of £5,000,000.

There was little change in the output of diamonds and gold during the year; but with the starting up of the new plant at Mpanda in May, over the year the output of lead concentrates was doubled. There were large increases in the outputs of raw gypsum, salt and tungsten concentrates, and a small decrease in the sales of mica sheet. The production of other minerals remained fairly constant.

Diamonds

Further considerable delays occurred in the construction of the new treatment plant at the Williamson Diamond Mine. Originally planned for trial runs to start towards the end of 1954, the plant had not come into production by the end of 1955. This plant, designed to treat 7,000 tons a day, is costing some £3,000,000; it has been designed and built by Messrs. Fraser and Chalmers (S.A.) (Pty.) Ltd. and is the most up-to-date plant for the recovery of diamonds anywhere in the world.

Improved methods of cleaning concentrates have been incorporated in the pilot plant, as a result of which increased recovery of the smallest stones is obtained. While this has lowered slightly the average weight of diamonds won, the revenue has not suffered owing to the general increase in prices. At the neighbouring Alamasi Mine production continued normally. A number of improvements are gradually being incorporated in the treatment plants installed at this mine.

Gold

Production from the Lupa Goldfield is gradually dying out. While the closure of some producers is anticipated, interest on this field is, however, by no means dead, and a revival of production from three moribund occurrences is now possible.

At the Geita mine production has been maintained—it would probably have been increased but for a temporary shortage of labour. During the year a considerable amount of new ore of good grade was developed. The Geita Gold Mining Company Ltd. have been granted a special exclusive prospecting licence over 123 sq. miles surrounding their existing lease and claims, and it is considered that the prospects of further orebodies existing in the vicinity are good.

The exploratory development programme at the Kiabakari Mine of Tangold Ltd., a company formed by New Consolidated Goldfields Ltd. and the Colonial Development Corporation, was completed during the year. The report of the consultants is now being considered by the Tangold Board.

Tanganyika's total production of gold in 1955 was slightly lower than in the two preceding years.

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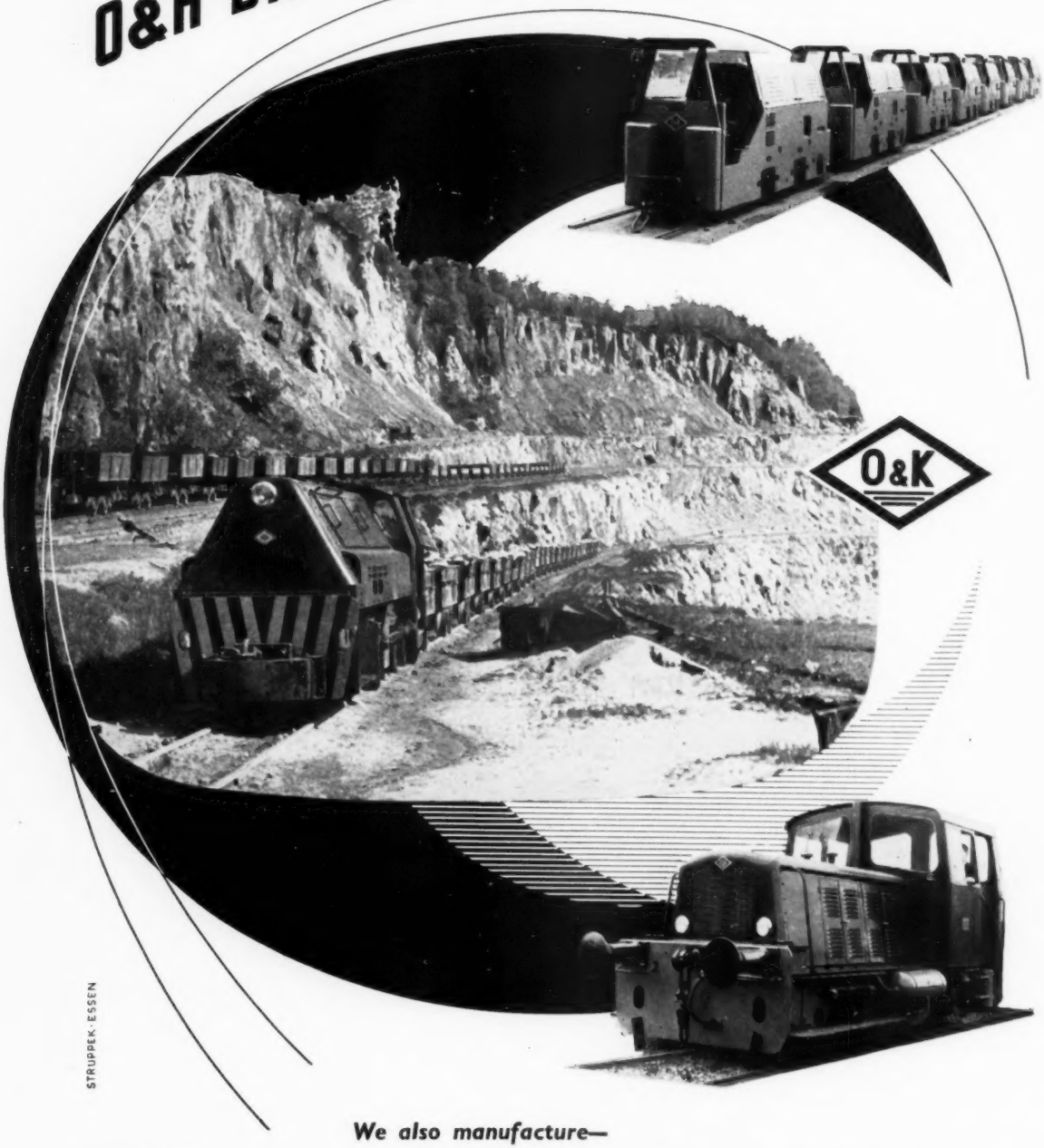

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Lead

In the last quarter of the year the milling rate at the Mpanda Mine was 28,000 tons a month, and after minor alterations in the plant it is expected to increase still further. The grade of ore mined was below average owing to the policy of mining by retreat from the far side of the orebody. The stopes are now leaving the fringe, and higher values should shortly be obtained. During the past quarter the concentrates averaged 47.3 per cent lead, 8.6 per cent copper, 38 oz./ton silver, and 0.8 oz./ton gold.

The method of ring drilling which was devised has operated very successfully. Long holes were drilled with Gardner Denver equipment, and the drilling efficiency is extremely good. During the last quarter of the year the working costs were 26s. a ton milled.

Repayment of the United States Government loan has been started, the company making available to the U.S. in the last quarter of the year 600 tons of lead and 120 tons of copper.

Mica

The slow decline in the production of mica is due to the weakness of the market for the smaller sizes. An improvement in the prices received would be likely to restore this industry to its former position. An all-African mica-mining co-operative society has commenced operations in the Uluguru mountains, and during the year produced over 17 tons of sheet mica.

Tin and Tungsten

Although 1955 showed increased outputs over the previous year, the future of these minerals is not very bright. At the end of the year the Colonial Development Corporation decided to close down their operations at Murongo. They had been testing the large Pitamber Reef occurrence, but the result showed it to be sub-marginal at present prices. This is a severe blow to the Karagwe Tinfield as there are several small high-grade occurrences which could have been picked up. None of these reefs is big enough to make a mine on its own, but they would make valuable adjuncts to a concern already operating in the neighbourhood. Hopes now centre on the Kyerwa Syndicate Ltd., a company controlled by the Straits Trading Company Ltd. Exploratory underground development has been proceeding on their large stockwork deposit and the results are eagerly awaited.

Niobium

The Mbeya Exploration Company Ltd., a subsidiary of Billiton with the Colonial Development Corporation, completed their Stage I programme during the year. This included further exploration of the carbonatite deposit, and tests on concentration in a small pilot plant. The results were successful, and the Stage II programme has been initiated. This involves the installation of a much larger pilot plant for tests on different types of ore. It is expected that this stage will take two to three years.

The Anglo American Corporation of South Africa Ltd. have applied for an exclusive prospecting licence over a similar deposit at Ngualla in the Chunya District. They had made a road to the property, which is somewhat inaccessible, when the onset of the rains prohibited further work.

KENYA

The value of the mineral production in 1955 was approximately £1,900,000—£120,000 more than in the previous year. The improvement was largely due to the increased production of soda and salt from the works of the Magadi Soda Company Ltd. on Lake Magadi. (The production of cement is not included in the foregoing figures.)

There was an increase in the value of gold produced, but it is probable that it is a mere flash in the pan and will not be maintained. There were also increases in the production of carbon dioxide gas and gypsum; but the outputs of kyanite, vermiculite and graphite declined.

Copper

During 1955 construction of the new plant at Macalder Mine (Macalder-Nyanza Mines Ltd.) was well advanced, and mining and milling are due to start in April, 1956. By the end of that year the full production of 10,000 tons of ore a month is expected to be achieved.

This plant employs the most modern principles of sponge iron production and sulphate roasting. This section is expected to start up in June, 1956. The cement-copper produced will be shipped to Jinja for smelting in the Kilembe Mines' smelter. The hydro-electric plant will not be ready until 1957, and till then standby diesel generating sets will be used.

Non-metallic Minerals

The production of mullite and kyanite was suspended during the year pending reorganization of the company, Kenya Kyanite Ltd.

Market contacts were firmly established by East African Minerals (Graphite) Ltd., both in the United Kingdom and the U.S.A.; and the company were, in consequence, able to sell all the graphite they could produce at satisfactory prices.

Underground mining by the pillar-and-stall method has been started by the East African Diatomite Syndicate on their property near Gilgil.

Niobium and Rare Earths

The existence of the Mrima Hill deposit has long been known, but active interest in the occurrence has only recently been aroused. It is now being investigated by the Anglo American Corporation of South Africa Ltd. The deposit is 10 miles inland from the coast, near the Tanganyika border. The hill is covered with dense bush and there is a thick cover of soil, both of which make exploration difficult. As a result of preliminary work done by the Geological Department, 26,000,000 tons of ore have been inferred, running 0.78 per cent niobium oxide with values in monazite and other rare earths also. The mineral is fine-grained, and the working of the deposit will have to depend on a satisfactory solution being found to the extraction problem.

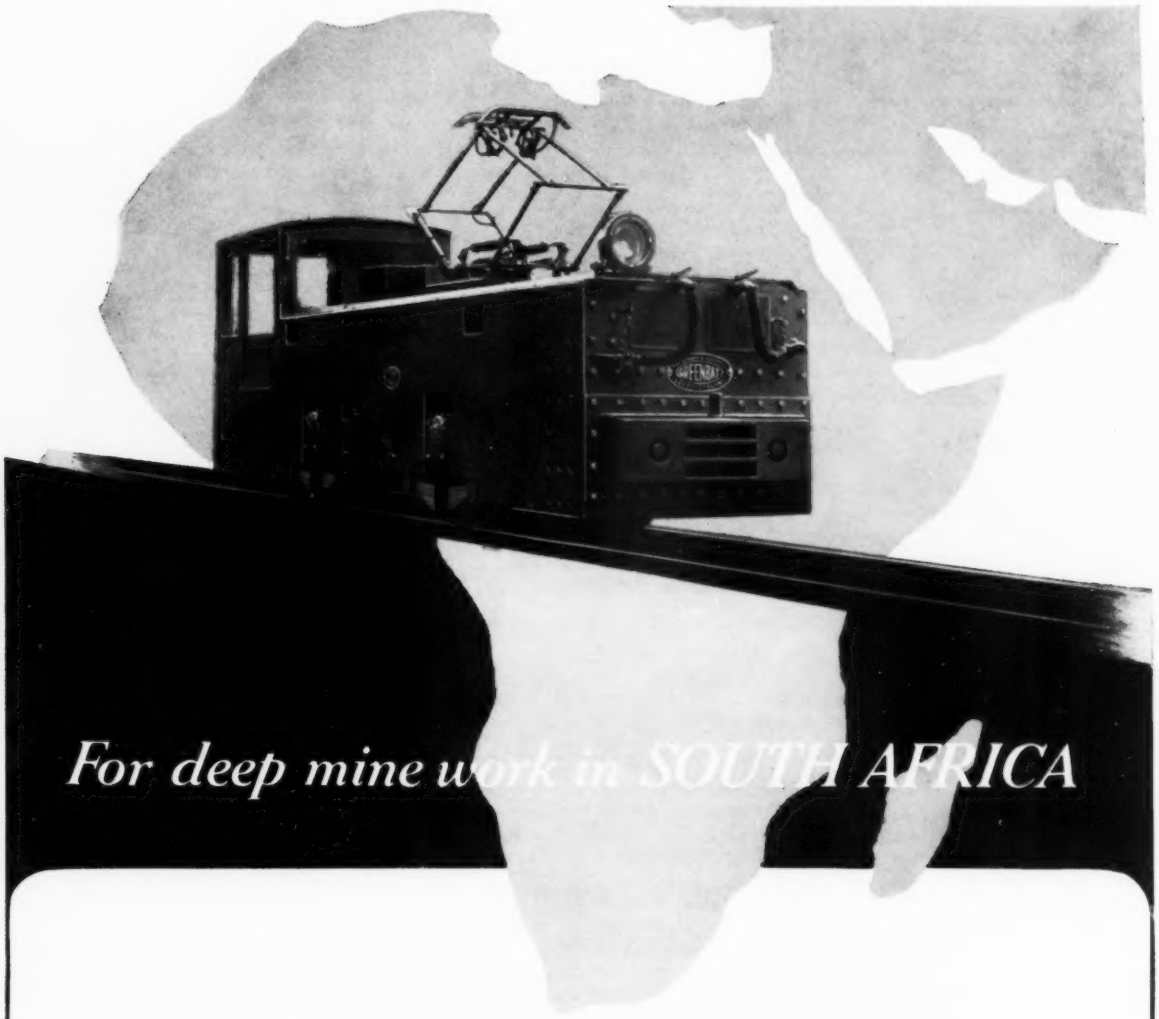
UGANDA

Excluding the values of salt and cement produced, the mineral production of the Protectorate declined from £254,000 in 1954 to £217,000 in 1955. This fall in production is largely due to a shortage of labour in the mining districts, and to increasing costs in the face of metal prices which remained fairly steady.

Tungsten

The value of the tungsten concentrates exported in 1955 was £111,839. The value of these in the previous year was £147,000.

Mr. H. Bjordal of Bjordal Mines Ltd. has installed, virtually single-handed, a new 200-tons-a-day concentrator which came into commission at the half year. Since then treble the amount of mineral has been produced, compared to the production won by the previous hand methods of extraction. The owner-operator of the mine is to be congratulated on the successful installation of this plant. Production from the other wolfram mines in the Protectorate declined considerably.



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Tin

The value of the concentrate shipped was just under £50,000, compared to £58,000 last year. Tin mining is seriously on the decline, as most of the deposits are of marginal grade at the metal price and the cost of labour at present ruling. Following an accident in which the mine captain and a pump boy died from the effects of gas, the lower levels of the Mwirasandu Mine have been abandoned

Tantalite/Columbite

Under the bonus prices offered by the American Government for these metals, considerable interest was shown by prospectors and many small deposits were discovered. When the American bonus programme was suspended the prices received fell from 672s. to 250s. a l.ton unit. Production was fully maintained owing to the impetus which had been gained; but under the present prices a considerable reduction in output must be anticipated in the future.

Copper/Cobalt

Construction of the new plants and the development of the Kilembe Mine have proceeded according to programme. The target date for production is June, 1956, and it appears likely that it will be achieved. All the main haulages have been completed and minor development is progressing. Nearly 250,000 cu.yd. of overburden have been removed in preparation for opencast mining on the upper part of the orebody.

Work on the concentrator is well ahead and most of the heavy equipment was on the property at the year's end. The 200 ft. chimney for the roast-leach plant at Kasese, several miles from the mine, has been built; and much of the equipment for the copper section of this plant is on the site. Work on the cobalt section has been deferred for additional testing, and this section is unlikely to operate before 1958. The intake works for the Mobuku hydro-electric scheme were completed, and work is now proceeding on the flume, power station and power line.

The only part of the construction work which is not up to schedule is the erection of the blister-copper smelter at Jinja. This is due to an unexpected shortage of steel. The 250 ft. chimney has been built, and it is hoped to have the smelter operating by October. Pending this the concentrates will be stockpiled.

Apatite

For some years research has continued on the Sukulu apatite-pyrochlore deposits at Tororo. These deposits contain over 200,000,000 tons of proved material, and under Dr. M. G. Fleming a successful mineral separation process has been devised. This may well result in the setting up of a large fertilizer plant at Tororo. It is presumed that pyrochlore will be produced as a by-product.

Hydro-Electric Power

A detailed examination is now being made of one of three sites for a new dam across the upper reaches of the Nile, near its source at Jinja on Lake Victoria. Surveys of a 19 miles stretch of the Nile above Uganda's existing hydro-electric station at Owen Falls have shown an additional potential hydro-electric capacity of 500,000 kW. The date of the start of building of any new station depends on the growth of use of electricity in Uganda, on exports of power to Kenya, and on the projected electrification of the East African railway system. It is likely that construction will have to start before 1960, and that building will take about five years.

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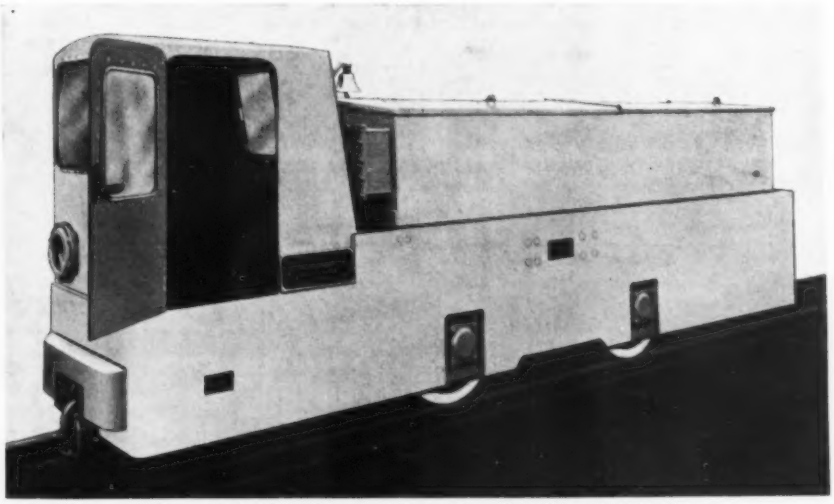

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The Belgian Congo and Ruanda-Urundi

By Our Own Correspondent

STATISTICS of mineral production in the Belgian Congo and Ruanda-Urundi have not yet been made available for 1955. This review of the year's activities is therefore based on export figures, obtained from the Statistics Department of the Belgian Government, which are given in the accompanying table. It can be stated, however, that during the first six months of 1955 mineral production showed a considerable increase over that of earlier periods, the best results being achieved by copper, diamonds, cassiterite, manganese and coal.

Copper

Copper exports rose last year to 230,791 tonnes from 226,760 tonnes in 1954. The increase in output was still greater, however, the corresponding figures being 253,780 tonnes and 233,791 tonnes. It has been possible to give these production figures because they have already been released by the Union Minière du Haut Katanga. The explanation for the disparity between production and shipments is that the mines and works of the U.M.H.K. are far in the interior of the Congo, while the Government takes account of consignments exported only when they leave the territory of the Colony. This observation is, in fact, applicable to all mineral exports.

Quite recently, large copper and lead deposits were reported to have been found near the frontier with Northern Rhodesia.

Cobalt

Exports of cobalt were lower because of a temporary decline in demand. Shipments of cobalt granules fell from 5,052 tonnes in 1954 to 4,980 tonnes last year and those of cobalt alloys from 8,056 tonnes to 7,141 tonnes.

Géomines' Production

Production in 1955 was 15,208 l.tons against 15,084 in 1954. Both cassiterite concentrates and tin ingots were exported in larger quantities in 1955 than during the previous year, concentrates increasing from 15,208 tonnes to 17,246 tonnes and ingots from 2,077 tonnes to 2,623 tonnes. This improvement came about in consequence of rather more favourable market conditions last year. In spite of the higher prices prevailing, however, some producers—chiefly small ones—had to suspend operations on account of uneconomic working costs. In this connection it should also be noted that not all producers were exploiting deposits in which tin is associated with other metals which could be profitably recovered. Even such a large producer as Géomines had to stop working its hard tin-bearing pegmatites on account of inadequate profit margins. It is now concentrating its activities, so far as tin is concerned, on the softer pegmatites, which can be more cheaply mined. The Géomines smelters are continuing to treat the company's own ores as well as those of other tin producers.

Géomines is also a coal mining company, but production is governed by the limitations of the existing market, which is not extensive. Nevertheless its coal reserves amount to tens of millions of tonnes and the coal is suitable for conversion into oil.

Other minerals produced by Géomines include tantalum, niobium and lithium. The company has patented, and successfully tested, a process for producing lithium carbonate. It is now studying the construction of a plant at Manono, Katanga, for producing lithium carbonate on a commercial scale, the raw material being the lithium ore, spodumene, which is a by-product of the crushing plant.

Géomines had a disappointing year in 1955, but, as has been seen, it is by no means exclusively a tin producer. In 1956 its new hydro-electric power station, Piana II, should be brought into commission and this should result in substantially increased production.

Diamonds

Exports of diamonds were also on a larger scale than during the previous year. Lubilash diamonds (mainly industrials and crushing boart) were exported to the amount of 12,378,516 ct. (11,573,837 in 1954), while shipments of Kasai diamonds (mostly gems) totalled 637,696 ct. (628,089 in 1954). The high proportion of industrials produced is the result of mechanization carried out by the Minière du B.C.K., which is using most powerful machines.

Gold

Shipments of gold from the Colony amounted in 1955 to 412,276 oz. compared with 398,000 oz. in 1954. The fact that exports were slightly higher in spite of the low market price can be attributed in part to the reluctance of the main producer to give up the schools, hospitals, farms, etc., which it had brought into being, but also to the desirability of increasing the gold reserves of the Colony, which is the chief authorized purchaser. Another organization, Congoor, which has been established to encourage producers to continue operating, pays a slightly higher price. Nevertheless, a number of producers have been compelled to suspend activities.

Silver

Practically the whole of the Congo's output of silver is produced by the Union Minière. Exports of silver increased from 40,110 oz. in 1954 to 47,400 oz. last year.

Zinc

A fall in exports of zinc concentrates from 120,632 tonnes in 1954 to 103,074 tonnes last year was not the result of lower output, but came about because Métalkat, a U.M.H.K. subsidiary, is now producing zinc metal. This development is reflected by an increase in shipments of zinc metal from 29,980 tonnes in 1954 to 33,228 tonnes last year.

Manganese

Manganese ores were exported in larger quantities, the totals for 1954 and 1955 being respectively 250,015 tonnes and 274,446 tonnes. The producers were Bécéka Manganese and the Sud-Kat.

Tantalum-Niobium Ores

Shipments of these ores were also higher, rising to 631 tonnes against 572 tonnes in 1954. This advance was accompanied by a decline in exports of tantaliferous slags, which fell from 2,736 tonnes to 1,450 tonnes. The Société Génerale Métallurgique de Hoboken is undertaking the magnetic separation of tantalum-columbium from Congo ores.

Cadmium

Cadmium is produced at the Kolwezi plant of the Société Métallurgique du Katanga. Early in 1955 this company brought a plant into commission for the recovery of germanium and cadmium from the dusts of the Lubumbashi smelter near Elisabethville. This has resulted in a

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This province, in area twenty times the size of Belgium, is the most heavily industrialised part of the Belgian Congo, and here the white population is at its most dense. This is the result of its important mineral wealth, the excellent communications into the interior and the sub-tropical climate. The C.S.K. representative is based on Elisabethville, capital of the Katanga province.

substantial rise in cadmium exports, which soared from 31 tonnes in 1954 to 140 tonnes last year.

Germaniferous Materials

Germanium is in growing demand for the manufacture of transistors and rectifiers in the radio and electronic industries. Last year the Belgian Congo, thanks to the U.M.H.K., became an important exporter, shipments amounting to 73 tonnes. These materials are shipped to the Société Génerale Métallurgique de Hoboken, in Belgium, which produces germanium oxide and electronically pure germanium. The process employed was discovered and patented by the company, which seems destined to become one of the major producers of germanium in the world.

MINERAL EXPORTS

	Unit	1954	1955
Copper	tonnes	226,766	**230,791**
Cobaltiferous products	tonnes	13,108	**12,122**
Industrial diamonds	thous. carats	11,574	**12,379**
Gem diamonds	thous. carats	628	**638**
Tin conc.	tonnes	15,209	**17,246**
Tin ingots	tonnes	2,377	**2,624**
Gold	oz.	415,000	**386,000**
Silver	oz.	40,500	**44,000**
Zinc conc.	tonnes	120,632	**103,075**
Zinc metal	tonnes	29,980	**33,228**
Manganese ores	tonnes	250,016	**274,446**
Tungsten conc.	tonnes	1,283	**1,506**
Tantalum-niobium ores	tonnes	532	**631**
Cadmium (inc. electro slimes)	tonnes	38	**145**
Tantaliferous slags	tonnes	2,737	**1,450**

Uranium Agreement with the States and Britain

No statistics are available regarding either production or exports of uranium. In reviewing the activities of the Belgian Congo in 1955, it is pertinent, however to refer to the conclusion of the new 10-year Belgian-U.S. agreement, under which Belgium undertakes not to sell nuclear materials produced in her territories to countries other than Britain and the U.S. without an assurance that these materials will not be used for military purposes. In return for Belgium's "unique contribution to western defence" by her wartime and current uranium supplies, the U.S. is to sell Belgium as much enriched uranium (U-235) as she can to meet Belgian needs for the peaceful application of nuclear energy, as well as supplying the technical information required for the purpose. The agreement gives the U.S. and the U.K. the right to buy up to 90 per cent of the Belgian Congo's uranium ore production for the next two years, but the former country is likely to be almost an exclusive buyer, since Great Britain is developing other sources of supply within the Commonwealth.

Control of Strategic Materials

A royal decree now in effect forbids the export from Belgian Congo, unless there is a special and preliminary authorization, of the ores, metals, special alloys and by-products of a long list of items including beryllium, bismuth, cobalt, columbium, lithium, magnesium, molybdenum, sodium, strontium, tungsten, tantalum, titanium, thorium, vanadium, zirconium and rare earths.

Hydro-Electric Power

The Minister of Colonies has approved the erection of a new hydro-electric undertaking in the Kasai. The site selected is the Katende Fall.

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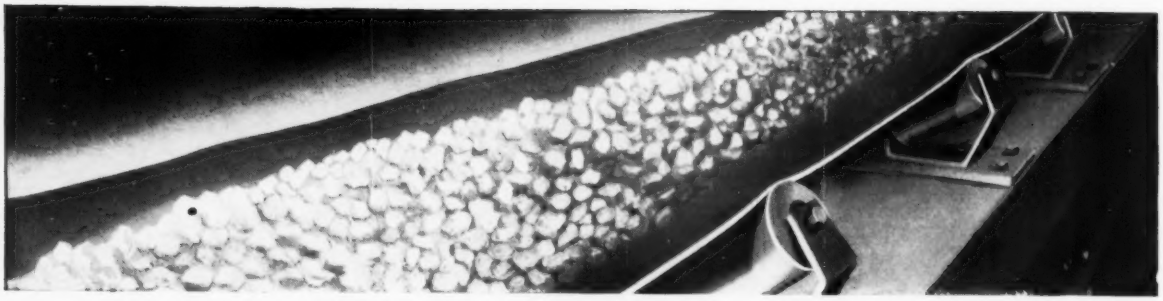

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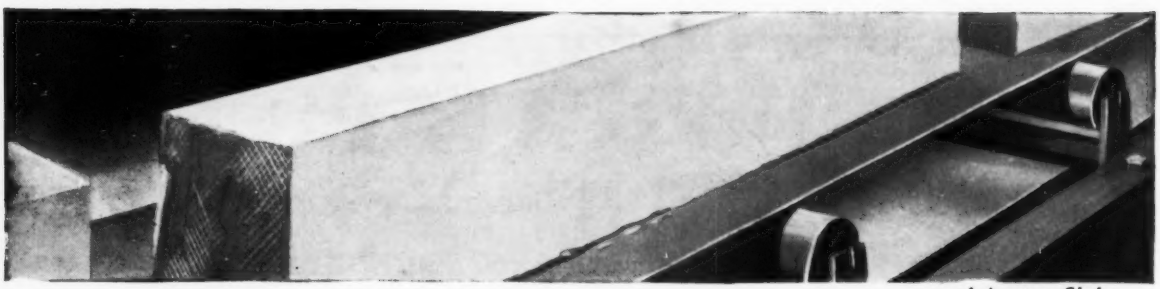

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The Gold Coast

THE Gold Coast's progress towards self-government is not proceeding as smoothly as perhaps Dr. Nkrumah, the Prime Minister, and his party could wish. Opposition, as represented by the Northern People's Party and the aggressive Ashanti National Liberation Movement (N.L.M.) has become increasingly insistent in its demands for a federal form of government despite the findings of a select committee that a federal system would be unnatural for the Gold Coast. The opposition movement has the support of the Chiefs, who naturally see eventually an end to their influence over their peoples in a central form of government from Accra.

A report in December, 1954, by Dr. Frederick Bourne, an authority on constitutional matters, recommended some devolution of power to regional assemblies and suggested also that no measures affecting the traditional functions of the Chiefs should be introduced in the Legislative Assembly without first consulting them. Such a compromise is not likely to win support from the opposition parties and in this respect the political outcome is obscure.

MINERAL EXPORTS

		1954	1955
Diamonds	ct.	2,159,224	**2,276,531**
Gold	f.oz.	788,736	**723,905**
Silver	oz.	48,214	**39,284**
Manganese ore	tons	460,245	**539,580**
Bauxite	tons	163,516	**116,285**
Other metallic ores	tons	4	**13**

Need for Investment

Cocoa remains the chief export on which the economy of the country largely depends and the fall in world price from a high of about £407 to a low of £212 per ton in 1955 emphasizes the vulnerability of the colony's financial position, and the need to develop secondary industries. This is receiving government attention, but progress is bound to be slow. It is dependent to a large extent on the view taken by foreign capital of the country as a field of investment, and in this connection the shortly expected report of the Preparatory Commission, which for the past two or three years has been investigating the various aspects of the Volta River Scheme, is awaited with interest.

Preliminary estimates of this hydro-electric project envisage a total cost of some £150,000,000 to be shared on the basis of £60,000,000 by the British Government, £40,000,000 by the Gold Coast, and £50,000,000 by Aluminium of Canada and the British Aluminium Company.

A notable event which took place during 1955 was the completion of the Achiasi to Kotoku railway, which opens up large areas of development and cuts the journey from Takoradi to Accra by 165 miles.

Mineral production, excepting manganese ore, for the current year will be seriously affected by a general strike of African workers which commenced on November 20 and which lasted for more than three months. The strike was in support of a claim by the Gold Coast Mines Employees Union for an all-round increase in basic wages of 15 per cent which the Chamber of Mines on behalf of its members felt it was unable to grant, and upon which the Union refused to arbitrate.

A Board of Inquiry to investigate and report on the economic condition of the mining industry (including gold, diamond and bauxite mines) with particular reference to the proposals made by the union for a revision of wages, and on the existing method of fixing wages in the mining industry, was set up by Government in January last. What benefits will arise from such an investigation is not yet apparent, but if it results in a clearer understanding by Government and the mines' employees of the industry's difficulties it will not have been in vain.

Gold Industry Hit by Strike

The first consequence of the prolonged strike was an announcement by the Taquah and Abosso Company that it was no longer in a financial position to bear the cost of keeping the mine open. Accordingly, on January 16, 1956, the workings were abandoned and there thus passed into history the oldest mine in the country, which in happier circumstances could have expected continued and not unprofitable operation for many years to come. Under present conditions of cost and the gold price, it would hardly be practicable to re-open the mine.

This was the second gold mine to cease production within 12 months, the Marlu company having closed down in May, 1955, owing to the exhaustion of its ore reserves. One other mine will shortly disappear from the list of gold producers though it is not expected that overall gold production will thereby be affected. Steps have been taken to liquidate the Lyndhurst Deep Levels company, the assets of which will be acquired by Konongo Gold Mines. Lyndhurst ore, however, will continue to be treated in the Konongo treatment plant.

Gold production from the mining industry last year amounted to 788,901 f.oz.; more than 53,000 oz. greater than the previous year's figure, and the highest since 1941-2.

Ariston reached its planned output of 40,000 tons per month in September, 1955, and Amalgamated Banket Areas maintained an output of 70,000 to 80,000 tons per month until operations were stopped by the strike in November. At Ariston, promising development results are reported on the 25th and 26th Levels, these being the lowest workings in the mine.

The sinking of Ashanti Goldfields 18 ft. diameter Eaton-Turner shaft was completed in August, the final depth of 4,354 ft. then being reached. It is expected that the installation, delayed by the strike, of the loading and spillage arrangements will be completed this year.

During 1955 Bibiani sunk an internal vertical shaft from the 17th to the 25th levels, this being an important part of a programme to explore below the Central and Northern ore bodies, where there was no evidence of the existence of major payshoots. Lateral development will first be undertaken on the 21st and 24th level horizons.

Monthly outputs at Gold Coast Main Reef fell slightly during 1955 which, combined with rising costs, resulted in the working profits falling from an average of about £10,000 per month in the first quarter to less than half that in the latter part of the year. Crosscutting on the 20th Level of the Bondaye Main Shaft was started to explore the Main and Spur Reefs at this elevation, these reefs being unpayable where last exposed on the 15th and 17th Levels respectively. Good values are reported from the bottom (15th) Level of the Tuappim Section.

Bremang Dredging, in company with the other gold producers, suffered severely from the strike of African workers. With the assistance, however, of its European staff it was able to maintain one of its four dredges in operation, and the revenue thus earned was a useful contribution to the company's finances. Bremang now has two dredges, transferred from the Ankobra River, working on the Upper Offin River, and it is planned to move a third to this area in the near future.

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Diamonds

In recent years there has been a considerable increase in the Gold Coast's diamond output, due largely to the greater production by Africans working on their own account. As can be seen from the accompanying table, production in 1955 was substantially higher than during the previous year. A major factor in this improvement was the greater yardage treated by Consolidated African Selection Trust, which rose by some 25 per cent. during the financial year ended June 30, 1955. The company's operating expenditure remained approximately the same.

The Geological Survey have for some time past been engaged in test pitting and evaluating African Diamond Digging Areas in the Oda and Tarkwa districts. Up to June 30, 1954, sampling and valuation had been carried out on 271 digging areas during which a total of 1,249 test pits were sunk. This work, which continues, does not constitute systematic prospecting and sampling as pitting is generally confined to the actual areas being worked for diamonds.

Bauxite

Exports of bauxite during the year amounted to 170,830 tons valued at £300,541, compared with 106,315 tons valued at £186,052 for the previous period.

Manganese

The only producer in the Gold Coast is the African Manganese Company at Nsuta, which last year exported 398,159 tons valued at £4,292,826, compared with 710,700 tons valued at £8,224,009 in the preceding year.

Despite a considerable increase in the rate of overburden removal at the mine, it is expected that ore production, and exports, will remain in the future at approximately last year's level.

The company's operations were not affected by the general strike which paralysed the rest of the mining industry since its employees remained at work, the Union's claims for increased wages having been met partially by the company at an early date.

Detailed investigations by the Geological Survey of the known manganese deposits of the Gold Coast has been in progress for several years. The main occurrence, in Ashanti, known as the Aserebusu deposit after the stream that adjoins it, lies in the Bibiani range some four miles south of the village of Mpesaso. Although some high grade ore is present, the tonnage available is too small to warrant exploitation at present in view of the remote location and difficulty of access. The opening up of the Yenahin bauxite deposits, some of which are close to the manganese body, may, however, makes its exploitation economically feasible.

Chromite

The Gold Coast Geological Survey has carried out detailed geographical and geophysical investigations of the Zanidaw area six miles south-east of Akuse, where chromite specimens had previously been found. Chromite outcrops were found in the valley near Bawhndyuku peak. It is suggested that some drill holes would be worthwhile to provide more definite evidence, particularly of the variation with depth of the intrusive bodies.

Africanization

At the beginning of the year (1955) eleven African Mining Trainees were employed by the mining companies in accordance with a Government sponsored scheme to provide opportunity for the advancement of Africans in the industry. Arrangements were made for six of these trainees to receive further training in the United Kingdom at the Camborne School of Mines, or failing that at a Technical School in Camborne.

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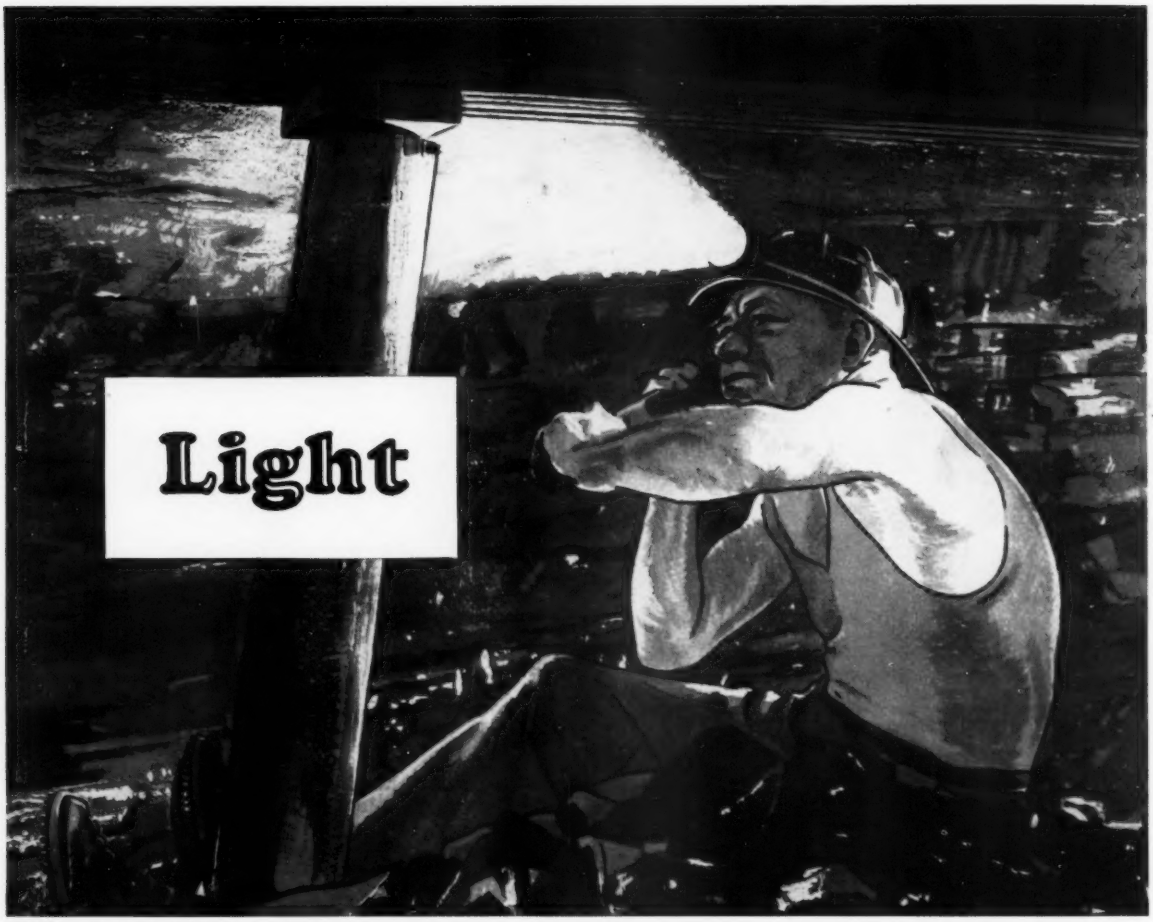

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Sierra Leone

UNSETTLED labour conditions had their repercussions on the mining industry of Sierra Leone during 1955. The costs of diamond production were substantially higher, due mainly to the inflated cost of the rice subsidy, but also to further increases in wages awarded by the Mining Workers' Wages Board, the Statutory body covering the whole industry. The drift from the farms by thousands of Africans engaged in illicit diamond mining led to a steep fall in the Colony's rice production and consequently the local price rose very sharply. Arrangements were made by mining companies to import their rice supplies in bulk at a much lower price.

Diamonds

Diamond production in Sierra Leone fell from 472,939 ct. in 1953 to 401,155 ct. in 1954. This trend was reversed in 1955 when Sierra Leone Selection Trust Ltd. produced 418,076 ct. from a throughput of 347,652 ct. The most memorable event of 1955 was the conclusion of an agreement between Consolidated African Selection Trust and the Sierra Leone Government. The company recognized the difficult position in which the Sierra Leone Government found itself in attempting to control illicit diamond mining in the face of a strong demand for the legalization of African digging. On the other hand, C.A.S.T.'s wholly owned subsidiary, Sierra Leone Selection Trust, was the owner of all diamond rights throughout virtually the whole territory for a further 77 years. For the sum of £1,570,000 the company has agreed to confine its rights to an area of 450 sq. miles, and that its rights over the smaller area should be further reduced to a possible period of 30 years. The 450 sq. miles still retained will support diamond production at present levels for many years and reasonable opportunities are provided for prospecting. It is hoped that the agreement will have favourable effects on public opinion and also that the granting of licences to Africans may lessen the attractions of illicit operations.

Other Activities

The Sierra Leone Legislative Council have ratified a new agreement with the Sierra Leone Development Company for the mining of iron ore in the Tonkolili district. The company will spend about £15,000 on development, including extension of the existing railway. Exports of iron ore in January-September, 1955, totalled 995,963 tons.

The Sierra Leone Chrome Mines Company Limited holds a special exclusive prospecting licence over 1,893.42 sq. miles for chromite only. Since 1936 it has opened up, developed and mined this ore from deposits in the Kambui Hills near N'gerihun. A prospecting programme by means of diamond drilling is being undertaken to prove ore to depth and locate extensions of the orebodies. In January-September, 1955, 14,600 tons of chromite were exported.

Interest was shown during 1955 in the possibility of developing titaniferous sand known to exist in the South-western provinces, which contains both ilmenite and rutile. British Titan Products Ltd. has been granted mineral rights over an area including the mouth of the Sherbro river.

British Aluminium has been prospecting for bauxite, but abandoned its licences after no deposits of commercial importance had been found.

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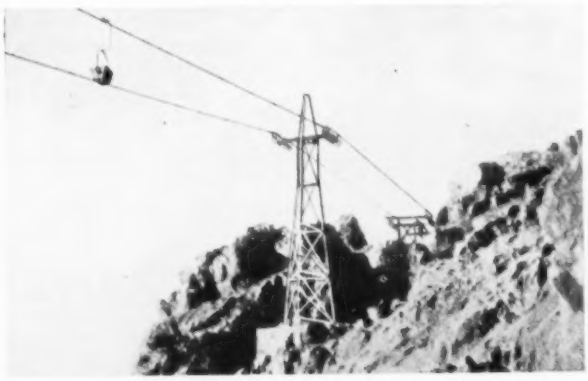

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Nigeria

WORLD attention was focused on Nigeria early in 1956 by the Royal Tour, during which the Duke of Edinburgh visited some of the country's modern mines. Nigeria has made encouraging progress towards self-government, but the difficulties of reconciling the conflicting interests of its diverse peoples are truly formidable. The effects of this bold experiment in the mining industry cannot as yet be foreseen, but the constitutional pattern should be more clearly defined as a result of the conference in August, 1956.

Tin Production

Nigeria is to-day the world's sixth largest producer of tin concentrates. Production in 1955 was very slightly greater than in the previous year, the respective outputs being 7,927 and 7,990 l.tons. The increase would have been appreciably greater, but for a strike of 30,000-40,000 workers in the minefields in Northern Nigeria in the last quarter of 1955. They were all members of the Amalgamated African Mineworkers' Union or the Nigerian African Mineworkers' Union; members of the Northern Mineworkers' Union did not go on strike. The dispute was centred on four major points, namely stabilization of tin prices, introduction of annual increments, payments of bonuses, and new rates of pay. As a result of the strike, the mining companies suffered a total loss of some 332 tons of tin and columbite. The All Nigeria Trade Union Federation have adopted a motion urging the Federal Government to nationalize tin and columbite mines.

Plant modernization, coupled with careful and successful working, enabled tin producers generally to maintain satisfactory margins of profit during 1955 and arrest the gradual decline of production which, in the absence of further discoveries, appears to be inevitable as existing resources become progressively depleted. Production costs continue to rise, higher wages for African workers accounting for as much as £23 a ton before the latest increases came into effect. On the other hand, the average price received for Nigerian concentrates was substantially higher last year, due to the enhanced price of tin metal. It had been expected that quotas would be introduced during 1955 under the International Tin Agreement, to which Nigeria is a signatory, but at the end of the year the Agreement was still awaiting ratification by Indonesia.

Columbite

The bonus of 100 per cent offered by the U.S. for columbite concentrates led to a very large increase in the Nigerian output, which rose from 1,855 tons in 1953 to 2,689 tons in the following year, the latter figure representing about 95 per cent of the total world production. During the first half of 1956 further substantial increases in output were recorded by leading producers. The outlook was abruptly altered in May, however, when the U.S. ceased to renew existing contracts or enter into fresh commitments for the purchase of columbite ore for the stockpile. Due to the cessation of American government buying, sales of columbite became very difficult and will remain so until commercial users come back into the market in sufficient quantity. Though some producers have succeeded in selling most of their output up to December, 1956, the price received is dependent on that ruling at the time of shipment. This setback is not reflected in the year's production figures, output during the first eleven months amounting to the record figure of 2,808 tons.

Nevertheless the long-term outlook for Nigerian columbite should not be viewed with undue pessimism. Having regard not only to the expanding outlets presented by jet engines, guided missiles, gas turbines and rockets, but also to the trend towards higher operating temperatures and pressures in the generation of electric power, demand for columbium as an alloying material for high temperature applications may well continue to outstrip available supplies.

Indeed, it will be recalled that the Kennecott Copper Corporation purchased a controlling interest in Tin and Associated Minerals, the important Nigerian producer, after the D.M.P.A. bonus had been dropped. This fact, together with persistent rumours of the need for columbium in the steel industry, makes the mid-term picture look better.

Lead

Mines Development Syndicate (West Africa) Ltd. applied for a grant of a first Mining Lease covering nearly seven sq. miles in terms of the Minerals Development Lead-Zinc Ordnance, 1952. The Federal Government have agreed to participate to the extent of £350,000 in underwriting an issue of shares.

Coal

According to the Geological Survey Department, which recently completed investigations, Nigeria's coal resources amount to 250,000,000 mineable tons, of which approximately 75 per cent are in the Northern Region. Hitherto most of the coal mined has been consumed by the country's own railways, but in 1955 Nigeria exported 80,000 tons of coal to the Gold Coast. Under an agreement recently concluded with the Gold Coast Government, the Nigerian Coal Corporation is to export 140,000 tons of coal to the Gold Coast during the next two years.

Oil

A renewed impetus to the search for mineral oil was provided during 1954 by the discovery of occurrences in the Opobo area and also at Aba, while slight gas and oil indications were obtained in several other localities. A government licence was granted in 1955 to the Socony-Vaccum Oil Exploration Company (Nigeria) Ltd. and prospecting is to commence very shortly near Sokoto in Northern Nigeria.

Search for Minerals

In its search for minerals the Geological Survey Department of Nigeria maintains close contact with the geological and laboratory staffs of Amalgamated Tin Mines of Nigeria. The Department's latest report records work on the distribution of columbite in the younger granites of the Jos Plateau, as well as in the Odegi, and Liruei, Banke and Tongolo Hills. High values were recorded at Odegi and Liruei.

Industrialization

Industrial developments envisaged in a recent White Paper on industrialization in the Eastern Region are likely to cost £1,500,000, according to the Industrial Panel of the Eastern Economic Planning Commission. British firms are associated with the expanding cement industry. A factory with a capacity of about 100,000 tons of cement per annum is being erected at Nkalagu, near Enugu, in the Eastern Region. Most of the capital is being found by the Nigerian Government, the Eastern Regional Government, and the Eastern Regional Production Development Board.

In March, 1956, a mission under Chief Obafemi Awolowo, Premier of Western Nigeria, visited Britain and the U.S. to interest business men in investing capital in the country.

LEARNING THE ROPES

The diagram shows the end section of a Locked Coil rope made by British Ropes Limited.

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A typical application of Locked Coil rope.

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The French Union

by R. E. RABUSSIER*

A HIGH level of mining activity was reported from nearly all French overseas territories in 1955. Prospecting and exploration have been vigorously undertaken and a number of promising discoveries have been made. In several territories large projects for the expansion of mineral or metal production are under way.

Algeria

Algerian iron ore production, purchased for the main part by the U.K., again achieved its normal rate of annual increase, after declining in 1954, owing to buyers' reluctance and freight difficulties. Output reached 3,600,000 tonnes in 1955, compared with 3,400,000 tonnes in 1953 and 2,900,000 in 1954. A very important deposit of semi-phosphorus mineral has been disclosed south of Tindouf (Gara Djebilet). It consists of 1,500,000,000 tonnes all running at 50 per cent iron or better.

While production of lead ore remains stationary, that of zinc ore is expanding. The rate of production of blende (over 20 per cent) goes a long way towards compensating for having to give way to the extraction of calamine.

Circumstances have necessitated a big decrease in Algerian pyrite production. During the first seven months of the year, the El-Halia mine produced approximately 20,000 tonnes of concentrates, but was obliged to stop mining. The Algerian Bureau of Mineral Research has completed its examination of a deposit at Beni-Saïd, estimated to contain some 400,000 tonnes of pyrite of 32 per cent sulphur.

Prospecting has confirmed the existence of a very interesting manganese deposit at Djebel Guettara, south of Colomb-Béchar. The reserves are estimated at some 1,500,000 tonnes containing 45 per cent manganese.

The Société des Pétroles d'Aumale continued its exploitation of the oil deposits of Oued Guétérini, but the field is becoming exhausted and it is thought that production will diminish progressively from 1955 onwards. Increased prospecting for hydrocarbon products is, however, being pursued on a larger scale than in the preceding year, with bigger capital investment.

METAL AND MINERAL OUTPUT

(in thousands of tonnes except where otherwise stated).

	1954	1955
Algeria		
Crude Oil	75.8	**57.4**
Iron Ore	2,927.0	**3,596.0**
Pyrites	33.5	**20.6**
Lead (concentrates)	14.8	**14.6**
Zinc (concentrates)	50.3	**56.8**
Barytes	19.4	**15.4**
Morocco		
Anthracite	486.0	**467.0**
Crude Oil	117.9	**102.5**
Manganese Ore	400.4	**411.3**
Lead (concentrates)	114.4	**122.1**
Zinc (concentrates)	62.9	**78.0**
Iron Ore	334.5	**309.7**
Cobalt Ore	7.4	**7.6**
Lead (metal)	26.7	**26.7**
Barytes Sulphite	9.3	**24.6**
Tunisia		
Iron Ore	950.0	**1,140.0**
Lead (concentrates)	41.6	**42.9**
Zinc (concentrates)	9.5	**9.8**
Lead (metal)	27.2	**26.5**
French West Africa		
Iron Ore	593.0	**650.0**
Bauxite	442.2	**423.0**
Ilmenite	11.4	**27.6**
Diamonds (in thous. cts.)	217.7	**318.0**
French Equatorial Africa		
Diamonds (in thous. cts.)	152.5	**136.9**
Lead (concentrates)	6.6	**6.4**
Gold (in kg.)	1,409.0	**1,448.0**
Madagascar		
Graphite	12.1	**14.7**
Mica	0.5	**0.3**
Beryl and Garnet	0.6	**0.5**
New Caledonia		
Nickel Ore	524.7	**994.0**
Chromite	84.2	**46.1**

Morocco

A slight reduction in the total coal production was recorded for 1955 at the Charbonnages Nord-Africains at Djerada (467,000 tonnes compared with 486,000 in 1954), but sales were higher, due to the availability of stocks which had accumulated in 1954.

Production of iron ore again suffered a slight decline in 1955, the further decrease of 10 per cent being attributable to the troubles at the mine at Ait-Amar, the biggest area of production. Once again Great Britain was by far the biggest buyer of Moroccan iron ore. Maganese ore production amounted to 400,400 tonnes as compared with 411,300 tonnes in 1954.

Marked increases are shown in the figures for lead and zinc ore production. For the first time the output of lead ore exceeded 120,000 tonnes, while zinc ore, with 78,000 tonnes, showed an increase of 25 per cent. A third of the lead ore is treated in Morocco at the Oued-el-Heimer works, the rest being sent to the Noyelles-Godault works in France. There is no zinc smelter in Morocco and France imports almost all the zinc ore produced for treatment.

Of the 26,700 tonnes of soft lead produced in 1955, 17,700 tonnes were sent to France and 7,000 tonnes were sent to the U.S.A., the latter quantity being mainly in repayment of the American loan.

The production of barytes increased from 9,000 tonnes in 1954 to 25,000 in 1955.

Cobalt is being mined at Bou Azzer, about 7,600 tonnes being produced in 1955, compared with 7,360 tonnes in 1954.

Progressive exhaustion of the deposits now being mined has resulted in a decrease of more than 10 per cent in crude oil production. Prospecting is being actively pursued, however, and some new areas have been discovered.

Tunisia

Production from the four iron mines increased slightly and reached an aggregate figure 20 per cen above that of 1954. The fifth mine, Djebel Ank, is still being used for research purposes and is being studied for extraction methods. Iron production for Tunisia exceeded 1,000,000 tonnes in 1955, a figure only reached for the first time in 1953. This achievement may be exceeded in 1957, when the Douaria group will have completed the installation of a treatment plant for the removal of arsenic content. The current year's production, however, for 1956 is not expected to be so high as that for 1955.

Although lead mines experienced great difficulties, due in some instances to a considerable decline in the grade of ore mined, production of lead increased by 3 per cent over 1954, but a slight decrease is expected in 1956. All ore is sent to Tunisian treatment plants, which export their products to France and Algiers. As can be seen from the table, the production of lead metal fell slightly in 1955.

Zinc ore output was maintained at the same level, in spite of the mine at Djebel-Ressas ceasing production. Only two mines remain in production, one of which is seeking to expand its extraction rate.

* Head of the Bureau of Mineral Documentation (Statistics).

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French West Africa

The Société des Bauxites du Midi is exploiting deposits on the Los islands in the region of Conakry. Exports which began in the middle of 1952, have now reached about 500,000 tons annually, of which the greater part goes to the Arvida works of the Aluminium Company of Canada. However, some exports were sent to Germany in 1955.

This company is pursuing an active prospecting programme for bauxite in the Cogon valley, north of Boké (Guinea). Exploration by the Pechiney Company has disclosed important reserves of medium-grade bauxite at the confluence of the Badi and Konkouré (Guinea). A hydro-electric plant is being installed with a view to the creation of a local aluminium industry. The size of the project may be gathered from the fact that the site at Souapiti alone will be able to supply 3,000,000,000 kWh. annually.

The Mining Company of Conakry is exploiting a deposit in French Guinea the iron content of which is in the region of 50 per cent. Production is increasing and is, at present, about 600,000-700,000 tonnes annually. It is expected to increase slightly in 1956. In Mauritania the deposit of Kédia d'Idjill, near Fort-Gouraud, has not yet been exploited ; it consists of haematite concentrates of about 65 per cent purity of iron, and the reserves should reach 100,000,000 tonnes.

The reserves of sulphide ore of the copper orebody at Guelb Moghrein, near Akjoujt (Mauritania) have a copper content of 1.7 per cent and have recently been estimated to contain 400,000 tonnes of metal. The reserves of oxidized ore are still being computed; it appears that they should be about 200,000 tonnes of copper, the metal content being about 2.5 per cent. Treatment of the sulphide concentrates presents no difficulties, and should give concentrates of 25 - 27 per cent copper but the process for treating the oxidised ore is still being studied.

Thanks to the existence of a modern treatment plant at Djifère, the exploitation of titaniferous and zirconiferous sands of the "Petite Côte" of Senegal, south of Rufisque has been expanding, and the quantities of graded ilmenite and saleable zircon are continually increasing. The Direction Federale des Mines et de la Géologie of French West Africa has found important reserves beneath the beaches and sand dunes.

Production of diamonds in French West Africa now amounts to about 1,000,000,000 French francs; prospecting is being actively pursued in Guinea, Ivory Coast and South of Sudan.

Cassiterite and wolfram mining in the "massif" of Aïr (Niger) has been decreasing noticeably in recent years. About 70 tonnes of cassiterite was mined in 1955 compared with 110 tonnes in 1954.

Considerable prospecting for oil took place in 1955, and very promising indications have been found, more particularly in the Senegal basin, also in Mauritania and the Ivory Coast.

French Equatorial Africa

The gradual decline in gold production, which has continued for more than ten years, was halted in 1955, when production, at 1,448 kg., was slightly higher than that of 1954. The number of small producers is still dwindling; of 34 operating in 1951, only 12 now remain. The future holds out scant hope.

The production of diamondiferous material from West Oubangui — the most important sector of French Equatorial Africa—declined by approximately 10 per cent. The same situation obtains in East Oubangui, where a decline of similar size was recorded. Nevertheless, prospects in this sector appear fairly promising, although deposits are variable and widely dispersed. In Gaboon prospecting has shown no new deposits and mining has been confined to the exploitation of known deposits. All that can be hoped for in 1956 is that diamond production in French Equatorial Africa can be maintained at the same level.

The important deposit of manganese at Franceville, in Gaboon, is being mined without delay, and 60,000,000 tonnnes have already been evaluated.

Madagascar

After the steep fall in graphite production during 1953 and 1954, in the course of which many producers disappeared, the situation has become a little better. Production is improving and exports have increased (16,000 tonnes in 1955 compared with 12,000 tonnes in 1954). The U.S.A. was by far the largest buyer in 1954, followed by France and Great Britain ; in 1955 the principal buyer was France, as in the past, closely followed by U.S.

The production of mica (phlogopite) dropped by almost 50 per cent in 1955. Sales difficulties which had obtained until the middle of 1955 have considerably diminished, however, and stocks are being reabsorbed. Shipments to Japan and Germany are increasing.

Piezo-electric quartz, which is required by the electronic industry, was quite actively exploited despite a tendency towards narrowing of the market.

Producers of beryl, garnets and other industrial stones are experiencing considerable difficulties, and sale prices reflect the drop in the market, due to the cessation of purchases for the American stockpile.

Thorianite deposits, discovered in 1953 and 1954, have been actively prospected, but their extent will not be fully known for several years.

Cameroons

The Cameroons produce small quantities of gold cassiterite (by Société " Les Etains du Cameroun ") and rutile, which showed some recovery towards the middle of 1955. Prospecting has also taken place for petroleum, molybdenum, copper and uranium. The Commission for Atomic Energy has applied for a general prospecting licence covering an area of 150,000 sq. km. Operations should soon begin.

Société ALUCAM is in process of building a plant for aluminium, in the neighbourhood of the Edea Falls, which will have a capacity of 45,000 tonnes annually. This undertaking, which comprises the extension of the hydraulic plant and the electrolytic works, will enable the company to satisfy increasing French consumption, at least for several years. The impressive installations planned for Guinea and French Equatorial Africa (Konkouré and Kouilou works) will not be in operation before 1962.

New Caledonia

The production of nickel ore, which reached 525,000 tonnes in 1954, was raised to 994,000 tonnes in 1955. Exports to Japan were 336,000 tonnes compared with 150,000 tonnes in the previous year. The production of nickel amounted to 10,100 tonnes of nickel in various forms (8,400 tonnes in 1954).

Owing to the world shortage of nickel in 1955, New Caledonian producers had no difficulty in finding markets. World metal prices were stable, but the price was raised in France in November, 1955. Projects for modernizing the nickel industry are rapidly taking shape. A dam will be built over the Yaté river by a recently formed company know as " Eneral " in order to supply the necessary power for the fabrication of 10,000 tonnes of nickel, and a new smelter will be constructed.

The mining of manganese ore was suspended in 1955.

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Canada *By Our Own Correspondent*

CANADA'S mining industry registered unprecedented growth during 1955. Metals and minerals became revealed in increasing variety and volume in each one of the nine provinces, as well as in the Yukon and the Northwest Territories. Production, both in volume and value, rose to the highest levels so far in the history of this young nation.

So widespread has the mineral industry of this country become that it is no longer possible to single out individual enterprises in the limited space available—but, rather, it has become necessary to refer broadly to each branch of the industry, or to entire mining camps in each of which may be a multiplicity of individual enterprises.

Entirely new mining fields are taking shape in various places, which have either commenced production already, or are in advanced stages of preparation to do so soon. These new camps are distributed at widely separated intervals across the entire continent. In a wide panorama, beginning at the Atlantic seaboard and moving across the country to the Pacific Coast, here are some of the fields in which new mines recently recommenced production or will do so in 1956. In each case growth of impressive magnitude may be expected in the years ahead.

METAL AND MINERAL PRODUCTION

	1953 (000's)	1954 (000's)	**1955 (000's)**
Antimony ..... lb.	1,488	1,302	**1,970**
Aluminium . s.tons	548	561	**608**
Asbestos ..... s.tons	912	924	**1,055**
Arsenious oxide lb.	1,404	1,180	**650**
Barite ..... s.tons	247	221	**202**
Bismuth ..... lb.	117	258	**207**
Cadmium ..... lb.	1,118	1,086	**1,971**
Coal ..... s.tons	15,900	14,913	**14,578**
Cobalt ..... lb.	1,602	2,252	**2,999**
Copper ..... s.tons	253	302	**324**
Fluorspar ... s.tons	89	118	**131**
Gold ..... f.oz.	4,056	4,366	**4,556**
Gypsum ..... s.tons	3,841	3,950	**4,798**
Iron ore ..... s.tons	6,510	7,361	**17,377**
Lead ..... s.tons	194	219	**194**
Mica ..... lb.	2,265	1,706	**1,186**
Molybdenite ... lb.	324	752	**1,289**
Natural gas M. cu. ft.	100,986	120,735	**143,699**
Nickel ..... s.tons	144	161	**175**
Oil (crude) .... bbl.	80,899	96,080	**128,811**
Platinum ..... f.oz.	138	154	**169**
Palladium, iridium, rhodium ... f.oz.	166	189	**211**
Selenium ..... lb.	262	323	**431**
Silver ..... f.oz.	28,299	31,177	**27,901**
Tin ..... lb.	1,092	167	**198**
Titanium dioxide s.tons	101	88	**114**
Titanium ore s.tons	9	1,541	**1,736**
Tungsten (WO_3) lb.	1,223	2,170	**2,282**
Zinc ..... s.tons	402	376	**427**

New Brunswick and Quebec

Several extensive deposits of ore containing lead, zinc, copper and silver have been discovered in New Brunswick and are under large scale development. Spearheading this new field is the work of Brunswick Mining and Smelting Co. which is being financed by St. Joseph Lead Co. interests, with plans for construction of a mill of 4,000 tons daily capacity, and with indicated ore reserves in the region of 55,000,000 tons.

Bathurst Mining Corporation is also playing an important role in this field, having indicated some 5,000,000 tons, and plans to go into production this year at a rate of 1,000 tons per day. This enterprise is being financed largely by New Brunswick Trust Co. and Falconbridge Nickel Mines.

In the Gaspe Peninsula area of Quebec, Noranda Mines is spending $40,000,000 on Gaspe Copper Mines, which enterprise is estimated to have close to 70,000,000 tons of ore. A plant of 6,500 tons daily capacity is being erected and is already partially in operation. In the Oka area near Montreal, Headway Red Lake and Coulee Red Lake are exploring a deposit in which some 15,000,000 tons of columbium ore have been disclosed. At Chicoutimi, Eastern Smelting and Refining Co., at a cost of $20,000,000, has developed hydro-electric power and erected a smelting and refining plant designed to produce 6,000 s.tons of nickel and 15,000 s.tons of copper annually. The control of this enterprise has recently been taken over by Mogul Mining Corporation, the same concern which recently has been taking an interest in Irish properties.

Then there is the Lake Allard area where 137,000,000 tons of iron-titanium ore has been disclosed and on which a programme of development, production, and research is in progress involving an estimated $30,000,000. This enterprise is now known as Quebec Iron and Titanium Corporation, in which control is held as to 66⅔ per cent by Kennecott Copper Corporation and 33⅓ per cent by New Jersey Zinc Co.

Farther north in Quebec is Canada's first lithium producer, the Quebec Lithium Corporation, where some 10,000,000 tons of ore have been indicated and where a plant of 1,000 tons per day went into production late in 1955, the ore containing 1.20 per cent lithium oxide. Still farther north is the Chibougamau copper-gold area where—in addition to existing producers—several mines are in an advanced stage of development and will soon make plans for production. Farther north in Quebec are the low grade iron ore deposits of great magnitude at Ungava Bay.

Ontario

Outstanding among the new mining fields in Ontario is that of the uranium field at Blind River. For reasons of national security, information is somewhat restricted. However, one property, Pronto Mines, went into production in 1955 with a plant designed to treat upwards of 1,000 tons of ore per day. Two other uranium mines are to come into production late this year in Blind River—Algom with two mills having an aggregate capacity of 6,000 tons daily, and Consolidated Denison with a mill designed to treat 5,700 tons daily. According to official details released late in 1955, the one plant on Consolidated Denison is expected to produce uranium worth about $40,000,000 annually. Algom Uranium, financed largely by Rio Tinto, which provided $41,000,000 for development and plant construction, is expected to produce around $40,000,000 annually.

There are several other properties in the Blind River field where ore of impressive tonnage is being disclosed by diamond drilling. The indications are that the uranium ore resources of the Blind River field will ultimately be measured in terms of 200,000,000 tons or more, yielding about 2 lb. of uranium per ton. The Ontario government is building a highway into the heart of the uranium field, scheduled for paving in July and August of this year, and in addition is directing the development of a new town site designed to accommodate a population of 15,000 residents.

Another new mining field of importance in Ontario is in the Manitouwadge area, now served by recently completed branches of the C.P.R. and C.N.R. Railways, where a milling plant is undergoing construction designed to treat 3,300 tons of copper-zinc-silver ore daily. Still another field of promise is at North Bay, where Beaucage Mines have built a small pilot plant for treating colum-

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Farther west in Ontario, in the Beardmore area, there are reports of what appear to be large deposits of spodumene, the ore of which carries lithium in commercial quantities. Then, too, in Ontario there are additional iron mines making ready for production in the Steep Rock area and in the vicinity of Red Lake. Meanwhile in the Haliburton Area plants are under construction for production of uranium from the new mines which are now being developed.

In the Prairie Provinces

A new nickel mine of considerable importance is taking shape at Ferguson Lake in Northern Manitoba, where International Nickel is conducting an exploration and development campaign on a low grade but large tonnage deposit. In the Cat Lake area of the province large deposits of lithium ore were brought under exploration and development in 1955.

In this province, too, the search for extensions of the petroleum deposits of the more westerly provinces is yielding increasingly important results and bringing important new wells both of petroleum and natural gas into production.

In Saskatchewan, a uranium-producing field of outstanding importance is developing at Beaverlodge Lake. Here Gunnar Mines spent upwards of $19,000,000 on development and construction, the mine being brought into production late in 1955 with a milling plant of 1,250 tons daily capacity. Negotiations are proceeding with a view to the construction of a custom plant for the treatment of uranium ores from several other smaller mines in the same area.

Meanwhile, Saskatchewan's petroleum industry is expanding at an impressive rate and now ranks second in importance in Canada only to the extensive petroleum fields in Alberta.

The main core of the petroleum producing areas of western Canada appears to be centred in the province of Alberta. Here it is that one of the major petroleum and natural gas producing areas of the world is taking shape. Not only are these products being made available for export in steadily increasing volume, but they are serving as a magnet in encouraging industrial development in Alberta because of the cheap and abundant fuel and power thus made readily available.

—In British Columbia

Cassiar Asbestos Corporation in north-eastern British Columbia, with ore reserves of over 7,000,000 tons, is planning to double its milling plant to 1,000 tons daily. Construction of a $152,000,000 gas pipeline has commenced, to run from the Peace River area to the Fraser Valley. The aluminium works at Kitimat is to undergo further extensive enlargement. Consolidated Mining and Smelting Co has completed its $78,000,000 construction programme, which includes hydro-power development as well as plant construction, all of which will contribute to the increasing production which is anticipated in the years ahead.

—And in the North-West Territories

In the Northwest Territories, a lead-zinc deposit of magnitude has been disclosed at Pine Point in the Great Slave Lake area, where Consolidated Mining and Smelting Co. has acquired about 50,000 acres astride the orebodies which extend for many miles in length. The Canadian Government is at present considering construction of a

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420-mile railway into the new area. A nickel mine of moderate tonnage is being developed at Rankin Inlet on the west coast of Hudson's Bay.

Rising Tempo of Expansion

The foregoing panorama deals only with new Canadian enterprises in the making. The impact of such developments upon future production is self-evident. Meanwhile, the already established mining industry produced at a new high record level during 1955—the value of the country's mineral output being almost four times as great as in 1939, and the momentum of growth is increasing. One mine, International Nickel Co. of Canada, is now producing nickel, copper, iron, and metals of the platinum group at a rate of over $400,000,000 a year. Iron ore production in Canada, which rose to over 14,000,000 tons in 1955, is expected to rise to 35,000,000 tons within the next five years.

Although the uranium industry is still in its infancy, the operators are looking toward production of uranium oxide at a cost of less than $5 per lb. Asbestos output has risen to almost $100,000,000 a year, while new discoveries have increased ore reserves.

The aluminium industry is looming up as a bulwark in the nation's industrial future. More and more aluminium is required each year in the manufacture of automobiles, and is going into a multiplicity of new uses in the constructional industries. In spite of curtailment of production late in the year due to power shortages, Canadian exports of primary aluminium for 1955 rose to the record total of 515,499 tons, an increase of more than 47,000 tons over 1954. With an installed capacity of 650,000 tons, of which only about 15 per cent is required for domestic consumers, Canada has become the world's largest aluminium trader. It is estimated that at least 75 per cent of all the aluminium moving in international trade originates in Canadian smelters. It is anticipated that by 1960 production capacity will exceed 1,000,000 tons a year.

To meet demands resulting from the rising tide of industrial development, the producers of motive power are being taxed to the limit. The Ontario Hydro-Electric Power Commission has outlined plans for some 25 years ahead, involving expenditures of $3,000,000,000 and in which the use of nuclear energy will play a vital role. B.C. Electric Co. plans an outlay of $75,000,000 in 1956 alone. A $40,000,000 power plant for Saskatoon, Sask., has been announced. Quebec Hydro-Electric Commission has announced plans to spend $495,000,000 on new power development in the next seven years. A plan for a Trans-Canada pipeline to carry natural gas from the West to the industrial east is making good progress, the estimated construction cost being over $350,000,000. The St. Lawrence Seaway development is progressing and will be completed late in 1958. Bell Telephone Co. of Canada plans expenditure of $137,000,000 this year in Canada. Canada's chemical industry produced over $1,000,000,000 in 1955 and is growing fast. Expansion includes heavy chemicals and is related to new natural resources development such as sulphuric acid.

So goes the story across the full breadth of Canada, with the governments, both provincial and federal, hard-pressed to keep pace with fast moving free enterprise, and with the consequent demand for more railway lines, the necessity for better and broader highways, the demand for increased immigration to meet rising labour requirements, and the need for credits with which to provide living accommodation for the rapid growth in population.

The toddling infant which was Canada a decade or so ago has finally risen to its feet and commenced to walk. Having regard to the basic strength of the Dominion's economy, the long range view is one of great promise.

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A Growing Mineral Empire

HIGHLIGHTS OF 1955

★ First Uranium ore taken from the billion-dollar Algoma-Blind River area. Three other Uranium mines in this district will be in production by 1957.

★ Exploration and development work continued in the Bancroft Uranium Belt.

★ Marmoraton Iron Mine in Southeastern Ontario began production.

★ At Steep Rock work proceeded to bring the third and largest iron orebody into production.

★ At Manitouwadge two copper-lead-zinc mines moved toward production. Two railway lines were built into the area.

With a target figure of $550,000,000 for the year's production ;

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The United States

By LEROY A. PALMER

THE mining industry stands on the threshold of 1956 in a mood of confidence tempered somewhat by conservatism. Economic conditions throughout the country in 1955 were better than ever before. With 1947-1949 as a base, the Federal Reserve Board's index of economic production reached 144 at the end of the year and was still climbing. Indeed activity increased to such an extent that some economists feared a boom and that the erection of new and the expansion of old plants ($29 billion in 1955) would bring about an era of overproduction to be followed inevitably by a bust in the "boom and bust" cycle. However, as Mr. Geoffrey Crowther, former editor of the *Economist*, has pointed out, "prosperity is really a matter of mass psychology" and business now seems to feel that, barring wholly unexpected events, 1956 will be another year of outstanding prosperity.

As an indicator, steel production reached a record 115,000,000 l.tons, 92 per cent of a theoretical capacity which no one expects actually to attain, and this without the benefit of wartime stimulation. Even so, the industry is behind in its orders, although capacity was increased by 2,500,000 l.tons during 1955.

MINERAL PRODUCTION

		1953	1954	**1955**	± %
Gold	000,000 f.oz.	1.96	1.83	**1.88**	+ 3
Silver	000,000 f.oz.	37.71	36.58	**36.73**	0
Copper	000 s.tons	926.45	835.47	**992.60**	+19
Lead	000 s.tons	342.64	325.43	**333.43**	+ 2
Zinc	000 s.tons	547.43	466.84	**503.80**	+ 8
Aluminium*	000 s.tons	1,252.01	1,460.57	**1,565.79**	+ 7
Manganese¶	000 s.tons	157.54	211.70	**297.84**	+41
Chromite	000 s.tons	58.82	163.37	**152.42**	− 7
Molybdenum†	000 s.tons	28.62	29.33	**30.74**	+ 5
Tungsten†	000 s.tons	4.63	6.57	**7.61**	+17
Mercury‡	000 flasks	14.34	18.54	**18.83**	+ 1
Iron Ore	000,000 l.tons	117.00	70.00	**98.28**	+40

* 75 per cent of bauxite ores imported.
† contained metal. ‡ 76 lb. each. ¶ 35%.

Minerals Policy

While production of minerals was at an all time high and mining shared the general prosperity, producers were disappointed that, politically, nothing they had hoped for was achieved. Doubtless the greatest disappointment was the President's veto of the bill to extend and increase the purchase of certain strategic minerals, including chromite, manganese and tungsten. The bill was supposed to be in line with Administration policy and passed both houses by large majorities, so the veto was a great surprise. It is the attitude of the Administration that international co-operation can be obtained only by a liberal trade policy, which must be maintained even at the sacrifice of some American interests. In November, at the behest of Governor Knight of California, a conference was called at Sacramento to formulate recommendations to Congress for a definite mineral policy. Seven governors attended in person and they were accompanied by a body of delegates chosen to give detailed consideration to the various questions and make recommendations to the Council of Governors who, in turn, will present them to Congress through their respective legislatures.

Basically the problems stem from a rise in production costs out of proportion to the market price of metals, largely due to increased labour costs which make United States industry particularly vulnerable to foreign competition. Naturally this brought up the subject of tariffs or of some measures that could be invoked in lieu thereof.

Duties on metals are specific and were set when prices were far lower than they have been in years. The average of all duties imposed by the United States is approximately 20 per cent *ad valorem* which is much higher than the *ad valorem* equivalent of the specific duties on metals. It is contended that if an *ad valorem* duty were set now at the same ratio of duty to price which existed when the present schedules were formulated it would not only afford relief to the producers but would also bring substantial revenues to the national treasury.

With the President obdurate and a Democratic Congress, there is no likelihood of an increased tariff being considered, especially while present prices prevail. As an alternative it was suggested that tariff receipts, or a substantial portion thereof, on each metal be distributed to domestic producers of the same in proportion to their production. Thus as imports increased to the detriment of a domestic producer his share of tariff receipts would be increased proportionately so as to help him stay in business. Such a plan would be a subsidy in effect but a subsidy which would pay its own way and lay no expense on the importer or ultimate consumer. The opinion of the conference was that relief could be achieved best by a direct increase in tariffs, perhaps on an *ad valorem* rather than a specific basis. Failing this, the favoured alternative was an indirect subsidy by paying the duties collected on each metal to the producers of that metal.

These discussions were slanted toward the strategic minerals and the base metals, particularly lead and zinc, but the gold industry was considered with a recommendation for a free market and discontinuance of the sale of monetary gold for use in the industry and in the arts.

While the mining industry is generally sympathetic with the Administration, especially in view of its principle of operating on a businesslike basis, there is a feeling of disappointment over its failure to establish a definite programme to cope with its problems aside from stockpiling, the ultimate effectiveness of which is somewhat doubtful. Plans are being made, especially among the Democrats, for the 1956 Congress to force the Administration's hand in setting up stockpiles, both for military purposes and to support the market, and to provide other relief measures as well. With the idea of beating the Democrats to the punch the Office of Minerals Mobilization of the Department of the Interior has appointed 14 advisory committees, each representing a specific branch of the industry and manned by men well qualified in that branch, to consider the various problems and offer solutions for them.

A bill to extend the purchase laws, such as was vetoed by the President last summer, has been reintroduced and a strong fight will be made for it, as some purchasing programmes will be completed in the near future and it is felt that these metals still need support.

Labour

An event of importance to all industry took place in December with the merging of the American Federation of Labour with the Congress of Industrial Organization, thus bringing into one big union 15,000,000 of the estimated 65,000,000 workers in the country. It is the hope of the mining industry that the consolidation will be beneficial to it. Non-ferrous mine labour has been dominated by the Mine, Mill and Smelter Workers' Union, a radical organization which was expelled in 1950 from C.I.O. for its Communistic tendencies, but nevertheless continued in control of the workers. Mine-Mill would like to affiliate

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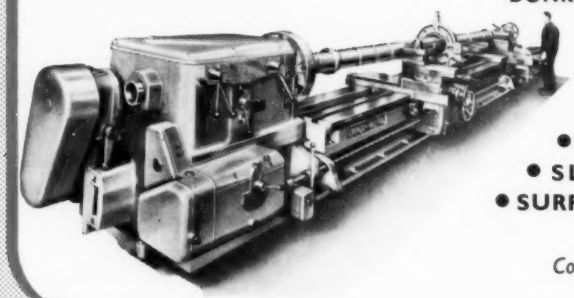

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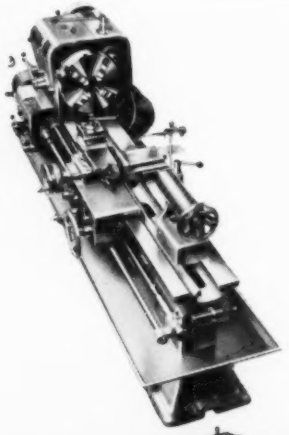

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with the consolidated organization, but so far the latter has turned a cold shoulder to all such advances, and it is expected that AFL-CIO will raid Mine-Mill's membership. A raid with so powerful an organization behind it would undoubtedly have its effect, at least to the extent of markedly lessening Mine-Mill's prestige. Operators will be pleased to have their employers represented by the more conservative union.

The most serious labour disturbance of the year was the strike called by Mine-Mill on July 1 against the major copper producers, which was not finally settled until August 15. Estimated loss of copper production is approximately 80,000 tons and this was accompanied by a loss in molybdenite, which is a by-product of some of the larger mines. With the more powerful union in the saddle and a year of expected prosperity ahead, the unions undoubtedly will be looking for their share of the good things and operators are expecting a season of tough bargaining in which they will be called on to grant increases in wages and fringe benefits.

Production

1955 broke all records for mineral production, total output of $15,800,000,000 topping by 10 per cent the $14,400,000,000 of 1953, the previous high year. Of the total, 69 per cent is credited to fuels, 18 per cent to non-metallics and 13 per cent to metallics. Non-metallics with an output of $2,866,000,000 and metallics with $2,010,000,000 exceeded 1954 by nine and 35 per cent respectively. While some of this increase in value may be attributed to higher prices, reference to the table, which gives outputs of the principal metals for the past three years, shows a general increase in volume over the preceding year. Some of the figures for 1955 can still only be estimated, and changes have been made in some of the former for previous years in the light of revised reports.

New Developments

Exploration has been carried on apace and in many cases with satisfactory results in the discovery of new orebodies, it being understood that it is only through the constant improvement of techniques in extraction and treatment that most of such discoveries can be classed as "orebodies". Perhaps the most important of these is at Butte where, after careful geological study, Anaconda initiated a churn drilling campaign which demonstrated copper ore tentatively estimated at 100,000,000 tons within an area of approximately 150 acres. This deposit is at a depth that makes it amenable to surface mining; and stripping is under way. In Tennessee, development in the vicinity of the Jefferson City-Mascot district revealed new deposits which an official of American Zinc, Lead and Smelting Co., principal operator in that state, estimates to contain as great a tonnage as all other deposits in their Tennessee properties. This company's Young mine was brought into production on this deposit during the year and New Jersey Zinc Co. is opening a mine in the same locality.

Copper production. The main blower supplying air during tunnel construction at the Butte, Montana, operations of the Anaconda Co.

The Missouri and Tri-State districts always have been considered as being shallow deposits, 600 ft. being a "deep" mine, but recent prospecting by drilling has demonstrated the likelihood of an important ore zone in the Mine LaMotte district at a depth around 1,000 ft. While exploration so far has not proven this horizon definitely there are distinct possibilities.

Exploitation of these new orebodies, all low grade, involves sufficient tonnage for large scale production, given a highly perfected technique in both extraction and treatment of ore. In mining resort has been had to block caving and open pitting as the outstanding methods. Particularly in the latter some notable projects are under way and under conditions that would have been considered out of the question not many years ago. In Utah, Continental Uranium Co. is stripping preparatory to mining from its Rattlesnake Pit, an operation which involves removing 2,500,000 cu. yd. to make available 118,000 tons of ore—an overburden to ore ratio of 35 to 1. At the Pima copper mine in Arizona stripping is under way to remove an overburden of 200 ft. of alluvium, while Pacific Coast Borax Co. (Borax Consolidated Ltd.) after operating its California mine for 30 years on the room and pillar principle is now converting to open pit. This involves removing an overburden of 450 ft. of soft shale which will present many features that will call for the highest skill on the part of the operator.

A jet piercing machine in operation at a taconite mine, Minnesota

Copper

Copper has been in the news so continually that there seems little more to be said. With the strike coming before the industry had recovered from the setback of 1954 and with foreign producers having their troubles the market tightened and the price shot up, from 30 c. at the beginning of the year to 43 c. by producers and 50 c. by custom smelters at the end. A weighted average for the year is approximately 45 c., highest since the Civil War, 90 years

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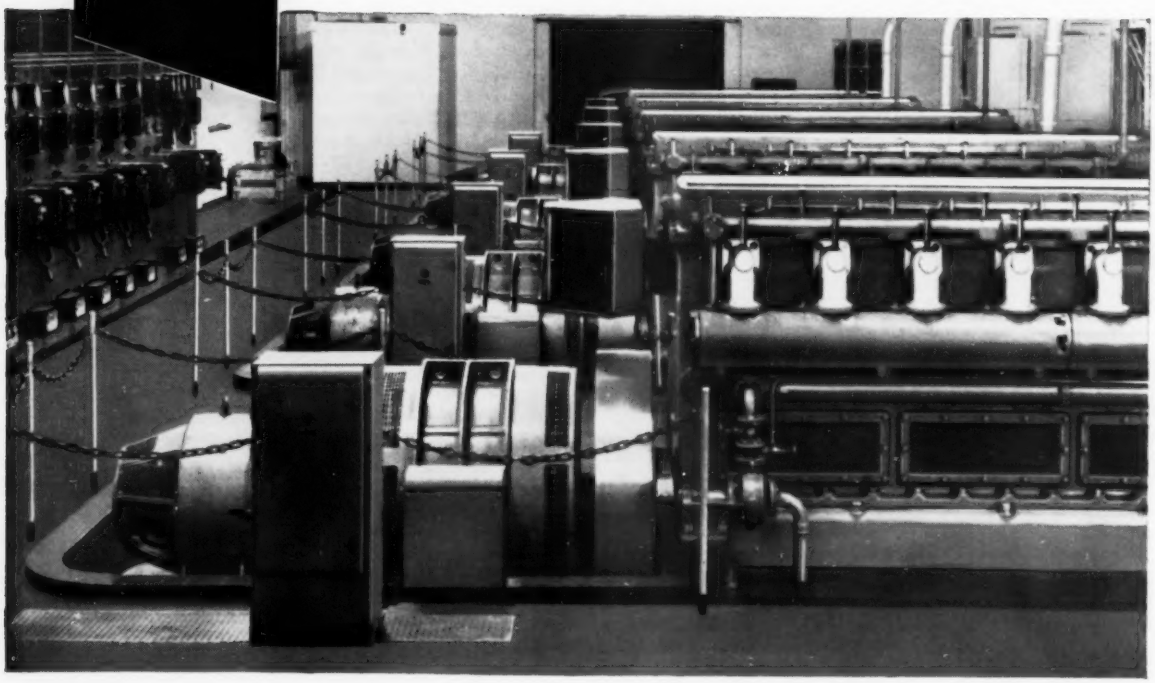

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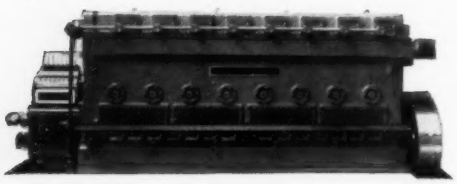

In the arid, semi-desert region of the Northern Cape Province, about 150 miles west of Kimberley, at the Cape Asbestos Company's Mine at Koegas there are five Crossley 8-cylinder four-cycle Diesel engines working in a central power station established early in 1951, when the first two engines were ordered together with a 3-cylinder unit for the compressor house. The remaining three engines were ordered during 1952 and 1953. Since installation, the 8-cylinder engines in the main power station have been on continuous 24-hour service.

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ago. In February, 1956, following representations by Chile, the price by producers was raised to 46 c. and by custom smelters to 53 c. With this stimulus production, despite the strike, reached the highest figure on record with the exception of 1943, which topped 1955 by 10 per cent), and would have exceeded 1,000,000 tons but for the interruption. Production of the by-products, gold, silver and molybdenite, increased, the latter to a new high and the former two to totals in excess of 1954 but still short of 1953.

Lead-Zinc

Lead and zinc shared in the general prosperity, prices advancing from 15 and 12 c. in January, 1955, to 16 and 14 c. in January, 1956, bringing the combined price very close to the figure of 31 c. which the Lead and Zinc Committee estimated to be necessary to assure sustained production, although it should be noted that the 31 c. figure was set two years ago.

Even with present prices the industry still is uneasy, since it fears in case of a recession in the market it might be dependent for support on government buying for the stockpile and no definite figure has been set as to date or tonnage for such purchases. Output of both metals was lower than for any year since the depression except 1954, a period of low prices and interrupted production.

Iron Ore

Paced by the steel industry, domestic production of iron ore exceeded that of 1954 by 40 per cent although still behind 1953 and preceding years. Great Lake shipments were the highest in years and taconite pellets came into the market as a definite source of supply.

Aluminium

Aluminium production set another record and still the metal continued in tight supply. Nevertheless the Government discontinued its "third round expansion plan" and declined further tax relief in the form of accelerated amortization, Reynolds, Kaiser, Alcoa and Revere are going ahead with large expansion plans.

Uranium

The most notable item about uranium is the definite trend toward emphasizing its importance as an implement of progress in peace rather than as a munition of war. During the year A.E.C. released much information, theretofore carefully guarded, and invited private industry to produce feed materials for atomic plants, particularly uranium metal and the oxides and fluorides.

In the industry consolidations, sales and other business deals that read like tales from the Arabian Nights continued. Outstanding during the year was the sale of the Happy Jack mine in Jan Juan County, Utah, for a cash payment of $10,000,000 with $20,000,000 more to be paid over the next ten years. Larger scale mining operations are in the making. Mention has been made of the Rattlesnake Pit of Continental Uranium Co. and now Homestake has started a 2,500 ft. incline shaft and other shafts heretofore considered to be deep for this locality are now on the way.

Following the Geneva Conference there were misgivings in some quarters as to the future of uranium, it being feared that there was a possibility of uranium being displaced by thorium. Assurances have been given from authoritative sources that thorium is not a real threat and that its only use is in conjunction with uranium and not as a replacement.

In a recent address Mr. R. D. Nininger of the Division of Raw Materials, A.E.C. stated that "we probably have yet no accurate realization of the ultimate size unranium requirements can reach".

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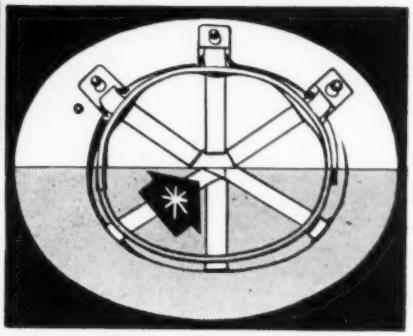

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Mexico

A VERY marked revival in some sections of the long-ailing mining industry contributed in no small measure to the economic recovery of Mexico during 1955. By the end of September foreign exchange reserves had almost doubled over a period of twelve months and were estimated at $327,000,000. As a result, Mexico was able to repay her debts to the International Monetary Fund. Confidence in the country's economic policy was shown by the unanimous designation of Mexico for the Presidency of the International Monetary Fund and International Bank for Reconstruction and Development.

In 1954 Mexico was again the world's largest producer of silver, production rising to 45,000,000 f.oz. compared with 39,000,000 f.oz. recovered in 1954. Over the same period, however, gold production fell from 396,000 f.oz. in 1954 to 380,000 f.oz. in 1955.

Non-Ferrous Metals

At the beginning of the second world war copper production in Mexico slumped to 40,000 tonnes and it was not until 1945 that it began to rise. After reaching an annual average of 60,000 tonnes it fell away to 54,676 tonnes in 1955, the contraction in output being attributed to extraordinarily high federal taxation.

Zinc production at 269,004 tonnes was higher, but the output of lead at 210,815 tonnes was slightly lower. Increases were recorded for graphite, mercury and arsenic, as the table shows. The output of mercury approximately doubled, rising to 1,030 tonnes from 509 tonnes in 1954. Mercury mining and beneficiation are carried out in various parts of the Republic, the bulk of the production being from the states of Guerrero, San Luis Potosi, Zacatecas, Durango and Querétaro. Lack of adequate laboratory facilities in the country has hitherto made it impossible to guarantee more than 99.8 or at the best 99.9 per cent purity and this has resulted in some prejudice against Mexican mercury in international markets.

OUTPUT OF PRINCIPAL MINERALS

		1954	1955
Gold	f.oz.	396,000	**380,000**
Silver	f.oz.	39,000,000	**45,000,000**
Copper	tonnes	54,806	**54,676**
Zinc	tonnes	221,000*	**273,000**
Lead	tonnes	216,624	**210,815**
Antimony	tonnes	4,154	**3,818**
Graphite	tonnes	21,784	**29,341**
Mercury	tonnes	509	**1,030**
Arsenic	tonnes	2,427	**2,954**

* Estimated

Uranium and Sulphur

The location of substantial uranium deposits in Oaxaca and elsewhere has raised the problem of the exploitation of this new source of industrial power. On October 25 President Ruiz Cortines submitted a bill to the Mexican Congress for the creation of a National Nuclear Energy Commission. This Commission will have complete control over the exploration for and exploitation of uranium, thorium and other radioactive materials, and also over the export, import and use of such materials. On October 6 the local president of the Cia Impulsora de Empresas Electricas, a subsidiary of the American and Foreign Power Company, announced that his company was prepared to install a 10 mW. nuclear power station in Mexico in the near future, if the Mexican Government would sign the necessary bilateral agreement with the U.S. Government.

Exploitation of sulphur continues to be carried out in the Isthmus of Tehuantepec by three American firms, two of which have completed construction of their plants. The first sizable shipment was made in March, 1955, when 7,000 tons of sulphur was dispatched to Britain.

It was estimated that by end-1955 sulphur production in the Isthmus would have reached 500,000 tons. Six new sulphuric acid plants will come into operation in Mexico during 1956 with a total daily production of 170 tons, using Mexican sulphur. Total production in 1956 was expected to reach 175,000 tonnes.

Iron, Steel and Oil

From October 23-26 the first Mexican National Iron and Steel Congress was held in Monterrey. It was pointed out during the Congress that the theoretical steel production capacity of the 18 concerns producing ingots in Mexico was about 900,000 tons per year, although only 622,000 tons were produced in 1954. The industry's chief difficulties are transport deficiencies,, temporary shortages of raw materials, frequent stoppages for repair of ageing machinery, and the fact that only two producers are integrated concerns. Two of the major steel companies have heavy investment programmes in hand. Mexico's iron ore reserves, mainly haematite, are estimated at 500,000,000 tons, while known reserves of coking coal are given as 2,000,000,000 tons.

Mexican crude oil production for the first eight months of 1955 was 62,400,000 U.S. bbl., or nearly 10 per cent more than in the corresponding period of 1954. Refinery outputs also show increases, especially in lubricants. Nevertheless Mexico is still importing more petroleum products (especially refined products) than she exports.

During 1956 Petroleos Mexicanos will spend 470,000,000 pesos on modernization. This modernization will include the construction of a catalytic cracking plant at the Ciudad Modero refinery.

Tax Concessions

The year 1955 ended encouragingly for the mining industry with the passing of revised tax laws which will assist both large and small mines, the latter group receiving the greatest benefits. Ever since the peso devaluation of 44.5 per cent in April, 1954, which brought with it a rise in export taxes from 15 to 25 per cent, mine operators have been petitioning the government to do something about the 19 different taxes which can now be applied to mining. About 800 mines, employing some 20,000 miners, will be affected. Several of the larger companies operating in Mexico have small units which qualify as small mines.

Under the old law, in effect since July, 1953, rebates were granted on a sliding scale to small miners whose production required them to pay 200,000 pesos in government taxes each month. The new law extends the mines covered to include those in the 250,000 pesos a month group. Miners paying up to 25,000 pesos on taxes will have a rebate of 75 per cent instead of about 60 per cent as formerly. Tax concessions granted the larger companies take the form of "convenios fiscales," or "special financial arrangements". Situations in which such concessions may become available include: working low-grade deposits; mining where natural conditions impose high costs; conducting exploration where reserves are dwindling; keeping marginal mines in operation; construction of roads, metallurgical plants, etc.; and renovation of equipment where the operator cannot afford the cost. The new laws should

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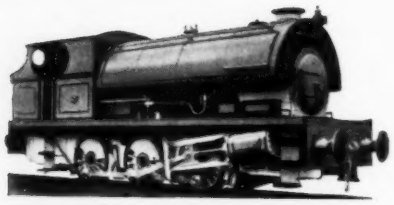

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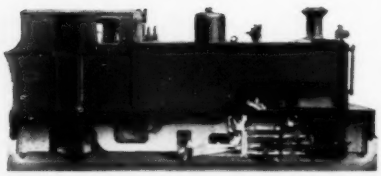
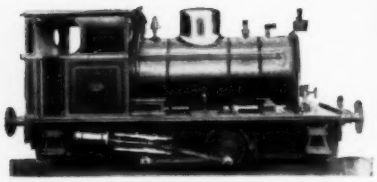


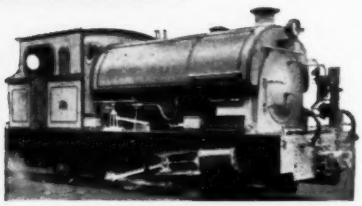
13" x 16" 0–4–2 *weight in W.O.* 29 *tons*

FIRELESS



12" x 18" 0–4–0 *weight in W.O.* 18 *tons*

STEAM



14" x 22" 0–4–2 *weight in W.O.* 42 *tons*

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The Caribbean

By SMITH BRACEWELL

THE mineral products of the Caribbean region include petroleum, bauxite, iron ore, manganese ore, gold, diamonds, nickel, cobalt, chrome ore, silver, salt, cement, gypsum, copper, lead, asbestos, coal, and magnesite. Venezuela is the second largest oil producer in the world and the largest single exporter. More than half the world's bauxite comes from the Guianas and Jamaica. Iron ore reserves in Venezuela exceed 500,000,000 tons and in Cuba there is the world's largest potential undeveloped reserve of nickel ore.

Bauxite

The largest of the world's most easily accessible reserves of commercial bauxite are situated in the Caribbean region, and during 1955 about 57 per cent of the Free World requirements of this ore were met by production from Surinam (Dutch Guiana), Jamaica and British Guiana. In Surinam annual bauxite output decreased by 400,000 tons to 2,900,000 tons but in British Guiana there was a slight increase of production to 2,435,282 tons.

Production in Jamaica increased from 2,043,786 dry tons in 1954 to 2,644,345 dry tons in 1955. Of the latter amount 2,182,043 tons (dried tons equivalent) were exported to the U.S.A. by the Reynolds and Kaiser concerns, and 462,302 tons were used by the Alcan subsidiary Alumina Jamaica Ltd. for conversion into alumina, of which 183,969 tons were exported.

The capacity of the alumina plant is to be increased from 210,000 l.tons to 490,000 l.tons per year by mid-1957. Reynolds Jamaica Mines Ltd. is adding another kiln, overhead tramway and larger storage facilities to their equipment in Jamaica. In view of these developments it appears probable that Jamaica will soon rank as the world's largest bauxite producing country.

It is anticipated that the Reynolds Mining Co. may shortly commence the mining of bauxite on their concessions in the Miragoane area in the southern part of Haiti. The Kaiser concern is also exploring bauxite deposits in the Forest of Pines area of Haiti.

In British Guiana explorations are being conducted by two companies in areas to the north-east of Mackenzie which have previously been regarded as of little interest. These are intended to test a theory that the bauxite horizon at the junction of the younger Corapina and the older Zanderij formations of Surinam may extend westward across the low-lying coastal areas of British Guiana. Aeromagnetic surveys are to be used by one company.

Reference is made elsewhere (under Aluminium) to the proposals to establish an aluminium industry in Surinam.

Manganese

In March, 1955, the British Guiana Government granted a Mining Lease covering the manganese areas of the North Western District of British Guiana to the North West Guiana Mining Co. Ltd., a Canadian subsidiary of the Union Carbide and Carbon Corporation of the U.S.A. The African Manganese Co. (Mines Management) Ltd., a company incorporated in the U.K., has been appointed by the company to manage the local operations. The lease is for a period of 33 years with a right of renewal for a further period of 30 years. Preparations are being made for mining the ore in the former area and the problem of transportation of the ore to a navigable point on the Kaituma River is being investigated.

Exports of manganese concentrates from Cuba during 1955 amounted to 266,243 tons.

Gold and Diamonds

Gold production in British Guiana decreased from 26,938 oz. (crude) in 1954 to 23,765 oz. in 1955. Of the latter amount 19,680 oz. (18,334 f.oz.) was produced by the British Guiana Consolidated Goldfields Co. from dredge working.

Work by the Waddington dredge in the Mahdia River has now been closed down and the only dredge operating is that at Tumatumari in the Potaro River. The new dredge in the Konawaruk River and the new hydro-electric plant at Tumatumari Falls are expected to be completed during the early part of 1956.

Diamond production in British Guiana increased from 30,073,000,000 ct. in 1954 to 33,300,000,000 ct. in 1955.

Petroleum

Petroleum production continued in Venezuela and Trinidad. Venezuela's production during 1955 amounted to 113,000,000 l.tons. Oil has been discovered in the marine wells drilled off the western coast of Trinidad, but the production rate is reported to be low. Satisfactory production is being attained from directional shore based wells.

In October, 1955, it was announced that an agreement had been reached between the Government of Jamaica and the Standard Oil Co. of Indiana concerning the further exploration for oil and the exploitation of any oil found in Jamaica. The occurrence of oil and natural gas is reported to have been noted in the first well drilled and a site for a second test well was chosen.

In British Honduras explorations for oil were continued by the British Honduras Gulf Oil Co. A test well was commenced in June, 1955, at Yalbac, about 12 miles north-west of Orange Walk on the Belize River.

Iron Ore

The mining operations of the Orinoco Mining Co., a subsidiary of the United States Steel Corporation, at Cerro Bolivar in Venezuela continued to expand during 1955 and in consequence iron ore production in Venezuela by this company and the Bethlehem Steel Co. was expected to increase from 5,300,000 tons in 1954 to about 8,300,000 tons in 1955. Iron ore deposits recently found in Jamaica are being investigated.

Nickel and Cobalt in Cuba

According to the U.S. Bureau of Mines, the nickeliferous iron ores of Cuba represent the largest potential sources of nickel in the world. Ore reserves containing one per cent or more of nickel are estimated to total 356,000,000 dry s.tons containing about 4,646,000 tons of nickel and there are in addition 1,653,000,000 tons of ore with an average nickel content of 0.8 per cent. The treatment plant at Nicaro belongs to the Cuban Nickel Co., which is owned by the U.S. Government. Since March, 1955, output has been at the rate of 16,500 s.tons per year. The ores come from claims owned by the Nicaro Nickel Co., a subsidiary of the Freeport Sulphur Co., and the government enterprise is managed by the Nickel Processing Corporation.

The Freeport Sulphur Co. has completed a plant at New Orleans which will be used for testing the nickel and cobalt ores from the Moa Bay area in Cuba. A 10,000 ton shipment is being tested. On the successful completion of the tests the company plans to build a commercial plant with an annual capacity of 15,000 s.tons of nickel and 1,500 s.tons of cobalt.

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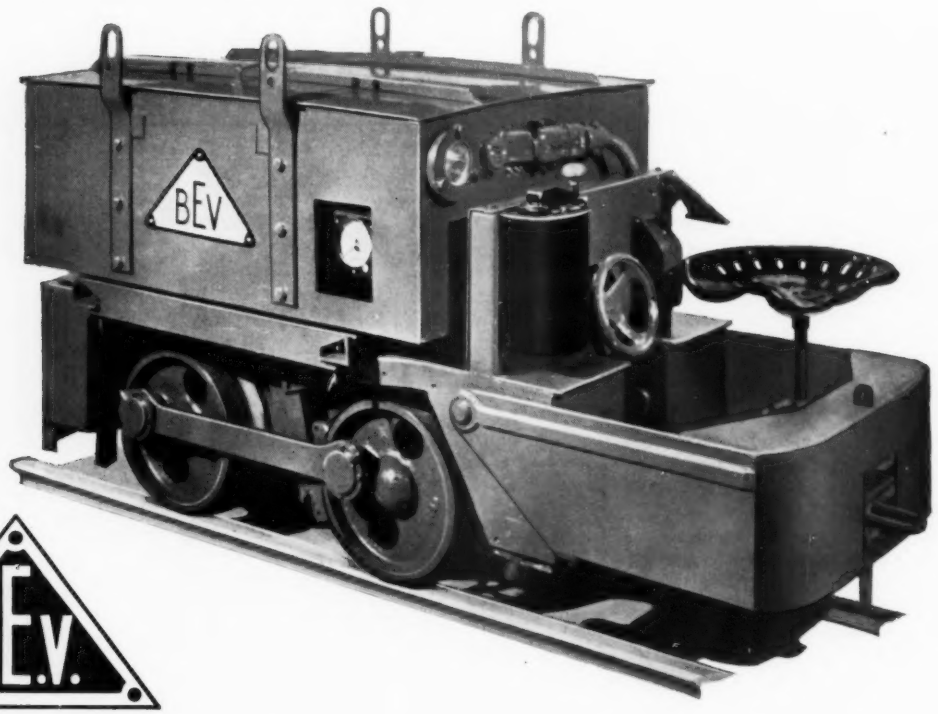

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Bolivia

BOLIVIA managed to make great strides in 1955 while remaining in grave economic difficulties. Unfortunately, she has been unable to control the inflation that is a danger to any development programme and which particularly threatens a government representing only wage-earners (and especially miners) whose demands it can barely withstand. The cost of living index rose between January and December, 1955, by 63.05 per cent. The free-rate of the Boliviano, which was 1,890 to the $U.S. on December 31, 1954, had gone to 4,640 a year later. As a result of a shortage of foreign exchange import firms have been put under close control and the use of barter has increased strongly.

Growth of Petroleum Industry

The outstanding developments were again in the oil industry; output at 2,700,000 bbl. was up by 59 per cent in 1954. Production of refined products also increased substantially. First deliveries of oil were made to Paraguay and Argentina in February. An oil pipeline (which Argentina is largely financing) is to be built from Camiri to the Argentine border and Bolivia is to pay Argentina in oil over 20 years for rail and road construction work. Bolivia is also building a pipeline from Oruro to the Chilean port of Arica to facilitate exports. Bolivia's debts to Brazil for rail and road work have been funded and are due to be paid in oil. Chile is bartering steel against YPFB oil.

OUTPUT OF PRINCIPAL MINERALS

	1954	1955		
	All mines	National-ized	Private mines	**All mines**
*Tin	29,357	23,483	4,189	**27,673**
*Wolfram	2,451	1,616	821	**2,437**
*Antimony	2,457	18	5,270	**5,288**
*Lead and silver	18,438	9,757	11,637	**21,394**
*Copper ..	3,589	3,252	266	**3,518**
*Zinc	15,305	17,608	907	**18,515**
†Gold	890	11	969	**980**

* tonnes. † kg.

On October 26 the new Bolivian Petroleum Code was issued. It established four zones and laid down the limits of exploration licenses, as well as the limits and duration (40 years) of concessions, the number of wells to be drilled and their depths, and the proportions of Bolivians to be employed. In addition to royalties and other taxes there is a 30 per cent profits tax. The code became effective in February, 1956.

Incentives for the Tin Mines

Various devices were adopted during the course of the year in an attempt to stimulate mineral output (particularly tin); in fact, output of most minerals was up in 1955 and the exchange earnings of minerals was $3,400,000 greater than in 1954. In the spring an administrative and technical re-organization took place in both the Bolivian Mining Bank (through which the small mines must sell their output) and the Bolivian Mining Corporation. The Bank was allowed to raise its buying prices from 120-160 per cent. Wage increases varying from 40-75 per cent were granted, exclusive of fringe benefits which were also raised. The various types of mines were granted the right to retain certain proportions of their dollar earnings for importing essential equipment. The medium mines were also allowed to conduct their own sales negotiations if they wished.

In September the Minister of Mines ordered the Bolivian Mining Bank to overhaul its procedures to expedite payments to mines under the spring incentive plan. Early in 1956 the proportions of foreign earnings retainable by small mines were increased from the 16 per cent originally fixed to 20 per cent. In September the Minister of Mines spoke at a meeting of unions and nationalized mines to discuss falling output and urged labour representatives not to interfere in technical and administrative problems.

In October Senor Lechin went to Europe to investigate the possibility of buying a tin smelter. Krupps has been associated with the project from time to time, but no scheme has come to fruition.

Estimates of the Bolivian Mining Corporation indicated that in 1956 nationalized mine production of tin will be about 25,300 tonnes, while private mines are expected to produce 5,100 tonnes

Other Minerals

In general, the Bolivian Government is now extremely anxious to attract foreign capital though still determined to prevent great concentrations. It desires fresh foreign capital to go into mining, but it is trying to insist that this should be on a contract basis. Bolivia signed the Investment Guaranty Agreement with the U.S. in September, and has taken an active interest in the Inter-American Investment Conference. The International Co-operative Administration has financed an investigation costing $162,000 by Ford, Bacon and Davis of New York into the Bolivian mining industry; recommendations will be made on mining, milling, smelting and refining, reserves, operations, management and so on. The possibility of a tin smelter will be studied and other minerals to be surveyed are lead, zinc, antimony, copper, tungsten, manganese, asbestos, sulphur, mica and mercury.

Two geologists began a study of the iron ore deposits of Mutun, in east Bolivia, in July. Ores were expected to show around 50 per cent. A Danish mining engineer reported in the Beni a rich deposit of manganese. Samples analyzed by the Bolivian Mining Bank showed 50 per cent. The Ministry of Mines is to carry out investigations.

An American firm, Bolivian Exploration and Development Co., received in November a 25-year contract for the exploitation of placer gold claims held by its associate, Bol-Inca Mining, along the Beni, Kaka and Mapiri rivers in west-central Bolivia. The company was required to secure $4,000,000 in backing and to have at least one dredge working inside 23 months.

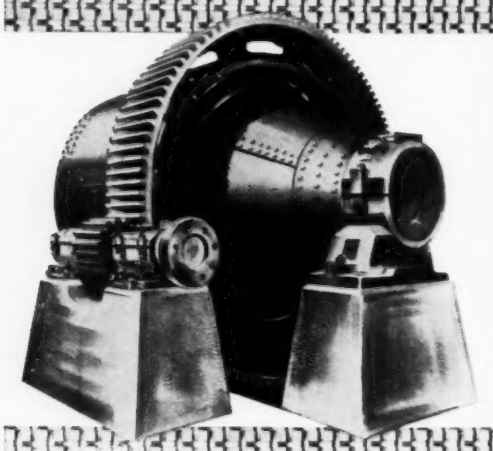
In June engineers of the Ministry of Mines began a study of the Covendo Triangle located on the junction of the departmental boundaries of La Paz, Cochabamba and the Beni to verify reports of radioactive minerals.

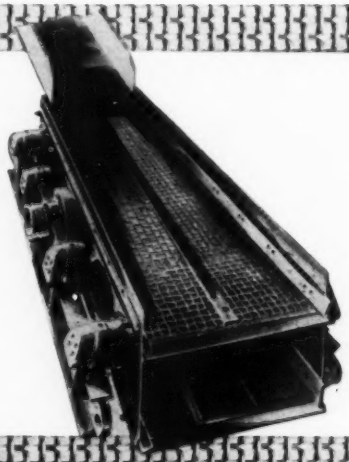
Metabol, a private mining firm, applied to the Export-Import bank in October for a loan of $600,000 to modernize and expand its smelter at Oruro for treating lead and silver.

The government has called for bids to exploit the zinc deposits of Mathilde mine (formerly of the Hochschild group) near Lake Titicaca. Large quantities of ore have already been blocked out and the mine is ready for immediate operation. This is the first time the government has offered to let private firms exploit a nationalized mine.

Agreement was reached with the Canadian-owned Bolivian Power Corporation for a $1,800,000 Carabuco power project to expand hydro-electric facilities in the Oruro mining area. This is expected to bring about a significant increase in mining activity.

IC *experience** COUNTS





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Brazil

By Our Own Correspondent

THE year 1955 was marked by intense prospecting and mining activities in Brazil. During the year the capital invested in 28 principal mining companies increased by £2,794,000—a figure some two-and-a-half times higher than the increase of £1,064,000 recorded in 1954.

The President of Brazil, Snr. Juscelino Kubitschek, has stated that an important aim of his Government is to attract private investment and technical aid, and that a realistic approach to the growing problem of the country's oil requirements and development of her own resources will be a "priority" concern. Early in 1956 Snr. Kubitschek visited Washington, London and Western European capitals, the purpose of the tour being to prepare a favourable climate of opinion for foreign investment.

Steel and Non-Ferrous Metals

The Bethlehem Steel Corporation was reported to be considering the installation of a steel plant at Minas Gerais to be sited between the high grade iron quarries at Itabira and Conceicao do Mato Dentro, where uranium bearing deposits have been reported. Bethlehem Steel is already engaged, in partnership with a Brazilian firm, ICOMI, in a large-scale project for the extraction of manganese in the territory of Amapa on the French Guiana border. A 140 mile railway has been half completed from Santana, a new port on the north channel of the Amazon, through dense jungle to the manganese deposits. Shipments should begin in 1957.

PRINCIPAL MINERAL EXPORTS
(In tonnes)

	1954	1955
Iron ore	1,678,445	**2,535,223**
Manganese	94,379	**193,273**
Mica	661	**838**
Quartz	630	**860**
Wolfram minerals	1,268	**1,093**
Bauxite	120	**680**
Tantalite-Columbite	170	**164**
Zirconium	1,200	**1,276**

Approximately 3,000 tonnes of copper ingots were produced in 1955, while the output of primary and secondary lead amounted to 5,800 tonnes. During the year Mineracao Sul-Brasileira began processing ores from a recently discovered lead mine at Blumenau, Santa Catarina, with reserves of 1,000,000 tons of galena. Cia. Brasileira de Aluminio started producing 3,600 tons of aluminium annually and Consorcio Metalurgica was formed to produce metallic nickel, nickel salts and alloys. Nickel is being produced by electro-metallurgical methods at Liberdade and some 3,900 tonnes of monazite sands are processed yearly, yielding uranium, thorium salts, etc.

Production of crude petroleum in Bahia increased from 992,416 bbl. in 1954 to 2,021,900 in 1955. Refining capacity was raised from 10,000 to 85,000 bbl. per day. Petrobras has inaugurated a pilot plant at Tremembe, State of Sao Paulo, for the refining of oil from bituminous schist deposits in that area. Installation of this plant is said to have cost U.S. $280,000 and Cr.$6,000,000.

Under the auspices of the National Research Council and the Atomic Energy Commission, a National Institute for Atomic Energy was established at the University of Sao Paulo. Work has started on Brazil's first research reactor, of "swimming pool" type, with a potential of 10,000,000 watt, which is to be installed in August.

Aerial Survey

The Geological Division has completed an aerial survey of 120,000 sq. km. between the Xingu and Tocantins rivers, in the Amazon Basin. Further south, American and Brazilian geologists co-operated in mineral research under the 1948 and 1955 agreements, which refer specifically to non-ferrous and radioactive minerals. By the end of 1955, 5,940 sq. km. had been mapped out in the iron ore quadrilateral of Minas Gerais. The entire aerial survey, embracing 50,000 sq. km., is scheduled for completion in 1959.

Radioactive Minerals

Deposits of thorium minerals have been discovered at San Rafaelo, Rio Grande do Norte, while thorium and uranium have been found on the Espirito Santo coast, at Ico (Ceara), Pocos de Caldas and Araxa, Minas Gerais. Valuable occurrences of tin-tantalum-uraniferous ores were proved at Sao Joao del Rei, Minas Gerais, and Volta Grande on Rio das Mortes. In December uraninite was discovered at Brejauba, Minas Gerais, and another deposit, thought to be carnotite, was reported from Petrolandia, in the Sao Francisco Valley. The areas of greatest interest in the search for radioactive minerals are now Serra do Jacobina (Bahia), Brumados (Sao Paulo), Serra da Moeda (Minas Gerais) and North-East Brazil. In 1955 the Department of Mineral Production (DNPM) located valuable deposits of monazite in 5-cm. crystals, associated with zirconium, at Floriania, Rio Grande do Norte. Other deposits were discovered at Sao Rafaele, in the same State, and in Rio de Janeiro, at Itabapoana and Manguinhos. In view of the continued expansion of Brazil's sources of radioactive minerals, DNPM's laboratory has organized a special section.

Other Minerals

The growing demand for asbestos coupled with the high cruzeiro cost of importation, have stimulated production of this mineral. Output has doubled since 1952 and now averages 2,600 tonnes annually. Imports have dropped in the same period from 11,000 to 8,000 tonnes.

Several new occurrences of silicated nickel ores, having two per cent nickel, were located in 1955 near the Liberdade mine in Minas Gerais. Deposits of copper ore were discovered at Bage, Rio Grande do Sul, and Jacupiranga in the Iguape valley, Sao Paulo. This region is proving to be an important source of nickel, silver, lead, tin and zinc. An occurrence of copper was found at Patos de Mina, Minas Gerais, and work was resumed in the copper mines of Rio Grande do Sul, where reserves are estimated at 1,000,000 tonnes. Production is about 8,600 tonnes annually. DNPM began examining two recently discovered occurrences of zinc, associated with lead and copper, south of Paraguacu, Minas Gerais. An occurrence of manganese with 67 per cent Mn was discovered at Obidos, Para, and another with over 40 per cent and exportable reserves of 500,000 tonnes was prospected and measured at Guacui, Espirito Santo. Deposits of galena have been discovered in various districts. In Araxa, Minas Gerais, an occurrence of columbium was discovered with reserves estimated at 3,000,000 tonnes.

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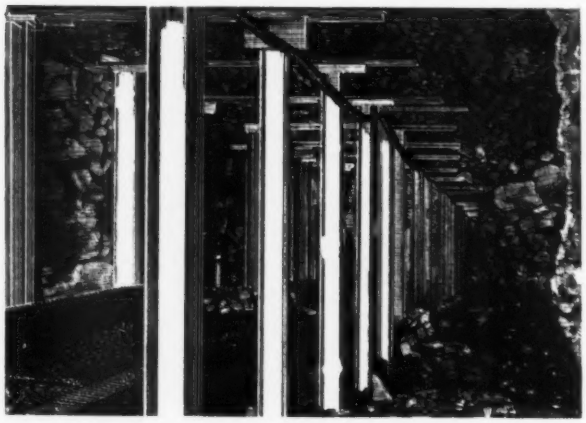

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Chile

THE past year was a successful one in many respects for Chile. The new copper legislation was finally passed (though the Government has still to solve some consequential problems); the country regained its place as the world's second largest producer of copper with an output of 435,000 l.tons against 364,000 in 1954 (it was helped in this by the strike of Africans on the Copperbelt); and a more purposeful attack was launched on inflation.

It became clear during the course of the year that Chile could not expect further loans from the World Bank or from the United States if inflation were not brought under control. The Government therefore appointed the Klein-Saks mission to act as economic consultants and it arrived in the autumn. Since then commercial credit has been restricted and a wage and price freeze has been instituted. Prices may be increased only by permission and wage increases in 1956 are to be limited to 50 per cent of the rise in the cost of living in 1955 which was estimated at 78 per cent; the base-date was planned to be in November but it was moved forward into 1956. The passage of the law was the signal for a general strike; however, this collapsed largely because the copper miners, who had only just ended their own strike, did not join it. Recently the peso on free markets has gained strength but there is a long way to go.

The big problem is to keep Government expenditure under control. In spite of the big copper revenues there was a deficit of 9,731,000,000 pesos in 1955 and a bigger one is expected for this year. Heavier taxation is expected and as much as possible of Government debt is to be funded.

Copper

The new copper law was passed and became law on May 5, 1955. The law provides for a "basic" output based on 95 per cent of the average of 1949-1953. Profits Tax is at a fixed rate of 50 per cent plus a surcharge of 25 per cent when output is at the basic level. Each one per cent increase in output up to 50 per cent will earn a reduction of one-eighth per cent in the rate of surcharge; an increase of more than a half of the basic output will earn a reduction of three-eighths per cent of the surcharge for each unit per cent of the increase over 50 per cent. If output falls below 80 per cent of the basic figure the total taxation would rise to 80 per cent unless *force majeure* can be proved. The copper companies are free to sell their output, but under the supervision of the Copper Department of the Central Bank. The companies must return acceptable foreign currencies sufficient to buy their peso needs which the Central Bank must provide at its free rate of exchange.

One consequence of the law is that it has encouraged the American companies to invest heavily in increasing copper output. In addition to a recent investment of $126,000,000 in a new sulphide plant at Chuquicamata, Anaconda is to invest a further $100,000,000 of which $37,000,000 is being spent on Chuquicamata to raise output from 250,000 to 300,000 tons a year, while $53,000,000 will be spent on opening up a part of the orebodies in the Turquoise Gulch area near the Indio Muerto mountain, about 20 miles from Potrerillos. It is expected that in about four years this area will be producing 100,000 tons of refined copper just as the Potrerillos mine is expected to be exhausted. Anaconda is also investing $2,000,000 in operating La Africana. During 1956 this mine will be producing at a rate of 1,200 tons of concentrates a month. Braden is investing $2,000,000 in the El Teniente mine and output may rise by as much as 25,000 tons a year from 1956.

A second consequence of the new law was that the copper companies were largely insulated from the effects of Chilean inflation by the granting of a free exchange rate for their peso needs. This was represented to the workers as a vast gain to the companies and they demanded, when the time came to draft a new labour statute under the copper law, a share of the augmented profits. A strike broke out in December which cost 30,000 tons and was settled by the President agreeing to drafting a new statute; it has not yet been completed.

A third consequence was that the sales policy of the American mines was a political issue throughout the year. The companies were free to sell their copper but the Copper Department was supposed to exercise a general supervision. The Copper Department was constantly pressing for a high proportion of copper to be sent to Europe where the prices were higher than in America and secondly was pressing for the American price to be raised to nearer the European level. In August, the Copper Department and Anaconda and Kennecott signed an agreement to sell 65 per cent of their output in Europe in 1956. Finally, in March, 1956, Anaconda agreed to sell their Chilean production in America at the London Metal Exchange price. What the year showed was that the power of the Copper Department to influence sales is not negligible, in spite of the fact that the passage of the bill was delayed because President Ibanez refused to accept the much stronger power which Congress wanted to give the Copper Department.

Nitrate

Progress was made with the plans for modernizing the nitrate industry, but they will take some years to fructify. At the close of the "nitrate year" on June 30, 1955, there was a surplus of 100,000 tons unsold and by June, 1956, another 100,000 tons will have accumulated. Barter agreements alone are helping to shift the accumulations which are caused by the growth of artificial fertilizer industries and by the high cost of much of Chile's output.

Petroleum and Coal

The Concon refinery was officially opened in November by the President and is working at capacity, refining 3,000 cu. m. a day. A pipeline is to be built from Concon to Valparaiso and to Santiago; Huachipato is to make the tubes. A bill to permit private interests to enter the oil industry was introduced to Congress by the government but later withdrawn on the ground that it was badly drafted.

Strikes and inadequate machinery hampered output and whereas miners in the soft coal mines were dismissed for lack of orders, Huachipato had to import large quantities of American coal. The Ministry of Mines has reported that the present seams in the Schwager field will be exhausted within seven years. The company is seeking loans of $1,900,000 and £1,600,000 to open up new seams beneath the sea-bed. New pithead gear and machinery were put into use during the year. New German machinery was taken into service in the Lota mine.

Other Developments

The government is considering plans for a lead smelting plant in Atacama province, the development of mining in Aysen, the modernization of the smelting plants of the Caja de Credito Minera, and plants for the lixivation of copper oxide.

The discovery of zirconium was confirmed at Hualqui near Conception and extraction is expected during 1956.

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Peru

IN 1954 Peru virtually wiped out her heavy oversea trade deficit and the outlook appeared good, but last year the economy drifted back. 1955 was not a good agricultural year and cotton exports were well down; exports of iron, which had made a big difference to Peruvian earning capacity in the past two years, fell away; exports of copper, lead and zinc more than made good the fall in agricultural exports, but were nowhere near high enough to account for the mounting import bill. Imports of consumer goods were to blame; they rose steeply, causing the reserves to decline, inflation to gather pace and the sol to come under selling pressure. Credit restriction in the autumn was tightened and the situation improved around the end of the year. But until more of Peru's development schemes pay off the fight against inflation will be hard.

Mining and Exploration

The mining industry enjoyed a particulary good year in 1955, with higher prices and increased production in all minerals except iron ore, where the Marcona Mining Company stabilized production after their all-out effort in 1954. All the previously active mines worked to capacity and some closed down marginal mines were re-opened.

MINERAL OUTPUT

		1953	1954	**1955**
		(000's)	(000's)	**(000's)**
Copper	tonnes	35.4	38.4	**42.0**
Lead	tonnes	114.6	110.1	**115.7**
Zinc	tonnes	139.1	158.6	**172.7**
Iron ore	tonnes	853.6	1,928.3	**1,765.0**
Gold	f.oz.	144.0	147.0	**145.0**
Silver	f.oz.	17,500	19,800	**20,000**

There was little fresh development in the plans for exploiting the three properties of the Southern Peru Copper Corporation at Quellaveco, Cuajone and Toquepala, which together have more than a million tons of low grade copper. No progress could be made till the Export-Import Bank had approved its loan of $100,000,000 on which the entire scheme depended and this was not forthcoming till the autumn. But as soon as it was announced, a contract for $2,000,000 for the construction of the port of Ilo, 110 miles from Toquepala, through which the copper is intended to be exported was placed with Foley Bros. of Pleasantville, New York. It is understood that Cerro de Pasco will own 16 per cent of the capital stock of Southern Peru Copper.

Cerro de Pasco is also working on the exploitation of Antimina copper deposits in the department of Ancash 70 km. north of Huallanca in the department of Huanuco. There are more than 70,000,000 tons of over one per cent copper. The company is considering building a road from Huallanca to permit more equipment to be moved to the mine for exploration. If exploitation goes ahead a 700 km. road will be needed from the mine through the Andes to a point on the Goyllarisquisga branch of the Cerro de Pasco railway.

The Mining Bank of Peru opened another custom mill —an 80 ton a day flotation plant—at Huarochiri about 100 km. east of Lima for the assistance of small and medium mines.

The volume of production of all metals increased again in 1955 and new records were established for a number of refined metals.

The year was an outstandingly successful one for the lead-zinc industry. Production and exports were both sharply up and prices were stronger. The rate of exports exceeded the rate of output in the early months while stocks were despatched, but after the first quarter they were pretty well in step.

During the year 1954 New York lead and zinc went as low as 12½ and 9¼ c. per lb., respectively but they closed 1955 at 16 and 13½ respectively. The United States continued to be the most important outlet and Peruvian producers remained apprehensive about the American mining industry's protectionist campaign. As a precaution Peru has sought markets in Europe and about half the exported lead and zinc is now sold outside the United States. During the year Compañia Minera Atacocha virtually doubled its facilities for concentrating lead and zinc ores.

An important tin ore deposit was discovered at Tambillo in the province of Huarez, 200 miles north of Lima. This is the first deposit of any size to be discovered in Peru although small quantities—up to about 60 tons a year of primary production—had been achieved since the war. By the end of the year claims had been registered for 30,000 hectares. The mineral content is said to vary between 9.75 and 10.85 per cent.

There have been occasional reports of discoveries of uranium traces in the past year—the second in which private firms have been allowed to undertake search—but none has yet been of first-rate importance. In December the control commission for radioactive substances, whose chief function was to supervise prospecting (including that of the American Atomic Energy Commission geologists) was replaced by a Board of Atomic Energy Control.

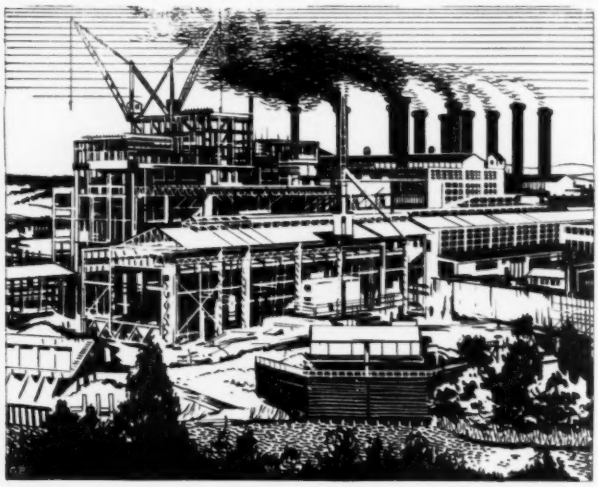
Iron mining, which went off with a bang in 1953 with the exploitation of the Marcona deposit, ran into trouble last year. Actually, output and exports were both cut back in the last quarter of 1954 and the cut back continued in 1955. In the first nine months of 1955 output was down by 36 per cent compared with the same period of 1954 and exports by 26 per cent. Peru began actively looking for alternative markets, particularly in Europe, and some trial shipments were made to Germany. Late in the year as the American economy boomed, exports and output both picked up. Peru will, of course, serve her own mill at Chimbote, when it is ready, with domestic ore. The first sheet steel rolling mill was expected in operation in April, 1956.

Petroleum

Oil output was around the same level in 1956 as in the previous year. News from the north-central region of Sechura was again disappointing. The rhythm of operations was heavily curtailed after a series of wildcat wells had been drilled and abandoned. Interest in the jungle area of eastern Peru remained as keen as ever. The total area under concession is approaching 40,000,000 acres. Nine companies qualified to make bids for concessions in the Montana area of east Peru (only those already holding 1,000,000 hectares qualified). Sealed bids were to have been opened on January 16, 1956, and no further applications will be allowed.

The latest government map shows that 17 companies now have concessions—these are all acreages taken up since the new law of 1952 and do not include the old areas held by International Petroleum, Lobitos and Empresa Petrolera Fiscal. The new oil refinery at Villar near Iquitos—a 1,500 bbl. continuous topping plant is approaching completion.

Last year a company was formed in which the Italian firm of Montecatini had an important interest for establishing a plant for producing, primarily, nitrogenous fertilizer. This will be the first petrochemical plant in Peru and will be set up in 1956 at a cost of $7,000,000. Explosivos S.A. has been formed to manufacture industrial explosives using materials from the fertilizer plant.



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Australasia

By Our Own Correspondent

IN Australia the production of ores and metals was well maintained in 1955, but there were no new discoveries of base or precious metals, such finds as were reported being extensions of more or less known orebodies. Old established companies have continued to produce at usual rates, and in some cases tonnage has been increased. The already high efficiency of the large operators has reached still higher levels, a factor which—particularly in gold mining—has been most important in meeting increasing costs. The continued merging of companies on the Kalgoorlie field has also been of benefit to the gold mining industry.

New Zealand's gold mining industry continued to decline and no new discoveries of alluvial have been made. Attention is being directed to the potentialities of the South Island's very large resources of titaniferous iron sands. The search for oil in New Guinea has given encouraging results, while nickel and cobalt deposits claimed to be very large have been discovered in Dutch New Guinea. Exploratory work in the Fiji Islands indicates a possible extension of the auriferous region, but the gold mining industry continues to be hampered by the incidence of taxation. Manganese is being exported from one of the islands.

METAL AND MINERAL PRODUCTION

	1953 (000's)	1954 (000's)	**1955 (000's)**
Gold ..... oz.	1,075	1,117	**1,049**
Silver ..... oz.	12,539	13,826	**14,060**
Lead ..... tons	269	284	**293**
Zinc ..... tons	239	252	**257**
Copper ... tons	37	40	**44**
Tin, refined tons	1.6	2.0	**2.1**
Tungsten ores, 65% WO_3 tons	2.2	1.4	**2.2**
Coal, black tons	18,412	19,761	**19,273**
Coal, brown tons	8,257	9,331	**10,112**
Iron ore .. tons	3,299	3,518	**3,719**
Rutile ..... tons	n.a.	44	**60**
Zircon ..... tons	n.a.	41	**48**

AUSTRALIA

The mining industry, in so far as prospecting or the re-examination of abandoned orebodies is concerned, has been affected by the general disappointment resulting from the failure to find further oil in Western Australia, and the inevitable failure of a number of uranium-seeking companies to locate occurrences of commercial importance. A large proportion of the optimistically floated oil exploration companies has now closed down and a revival cannot be expected until one of the several companies still prospecting, makes a commercial discovery. During a year of high copper price and improving market for lead and zinc, it has been noteworthy that no interest has been directed to the possibilities of the small, abandoned lead and copper mines, of which there are many, some of which might well repay investigation. Prospecting has remained with the big organizations such as Western Mining Corporation, Zinc Corporation, Broken Hill South and Mount Isa Mines, but the objective of these companies is a mine capable of large output, whereas in the not distant future Australian mining must turn more and more to the small mines. A bright feature of the year has been the keen interest taken in rutile and zircon on the east coast shoreline, in northern New South Wales and Southern Queensland.

Gold

Gold production may approximate that of 1954, although Western Australia has recorded a decrease for the year of 9,537 f.oz., with a total of 837,914 f.oz.; improvement cannot be expected until the price for gold is increased. The Commonwealth subsidy to assist marginal producers has been continued and has been useful in the field for which it was designed. The Gold Producers' Association, during a period of 12 months, continued operations which resulted in a selling profit, above the Australian standard price, of 6.54d. per f.oz This branch of the industry is most severely affected by the steady increase in wages and salaries, but rising costs continue to be met by increased efficiency.

In Western Australia, this, coupled with the better use of mills, following the amalgamations on the Kalgoorlie field, has assisted greatly in keeping ahead of costs. Kalgoorlie has maintained its output and dividends without drawing on higher grade ore. High grade producers—Central Norseman Gold Corporation and Hill 50 Gold Mine—have continued to win ore averaging 10 dwt. and better, while deep level developments at Great Western Consolidated indicate the winning of better ore in the near future, assisted by the favourable way in which the re-opened Fraser's mine at Southern Cross is responding to development. One new mine has been added to the list of producers, the Northern Hercules at Pine Creek, Northern Territory, which is an old abandoned mine re-opened and equipped with modern plant. Further south, Tennant Creek's two important mines have kept about the usual level of production and there has been activity in prospecting and exploration on the field. In Queensland, Mount Morgan continues to be the big gold producer, followed by the Golden Plateau, a mine with much improved prospects.

Copper

Established companies have benefited from the exceptional copper price, but this has failed to raise any interest in the re-examination of old copper mines which might have merit, except for small scale production of oxidized ore to supply a trace element in fertilizers. The three big companies—Mount Isa Mines, Mount Morgan and Mount Lyell—have increased output, which may exceed that for 1954 by some 5,000 tons, and a useful contribution has been made by the Peko mine, at Tennant Creek. Refining capacity at the Port Kembla works of Electrolytic Refining and Smelting Co. has reduced the quantity of blister copper shipped overseas for refining in the previous year. There is sound ground for the expectation that Australian production will soon equal the local demand for metal. Active exploration has been carried on by the three big companies. Mount Lyell is assured of enrichment and continuation of the main orebody; the open cut is to be deepened, and a new crushing station and transfer pass at the open cut will be constructed at a cost of £A325,000. Mount Isa Mines has reported important extensions to the copper orebody, and the company is now the premier copper producer in the Commonwealth. A proposal is being considered for the building of a copper refinery at Stuart, near Townsville, at an estimated cost of £A2,500,000. Copper ore reserves have been increased from 3,700,000 to 5,100,000 tons.

Silver-Lead-Zinc

Metal output has been maintained by all producers, and the position was helped by resumption of operations by Lake George Mines after a long strike. Several small producers in Western Australia are now operating. Developments on the Broken Hill field have continued normally, increasing tonnages of reserves over and above extraction. Notable is the proving by diamond drilling of the continua-

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tion of North Broken Hill's orebody to a depth of 4,050 ft. and the lode has been proved to increase in size below 3,070 ft. Broken Hill South maintained ore reserves at the level of the past 10 years, despite extraction, and is following an active policy of prospecting in the eastern part of Australia. At the south end of the line of lode, the outstanding event was the steady increase in output by New Broken Hill Consolidated. Electrolytic Zinc Co. has continued its policy of increased output from its West Coast, Tasmania, mines, the ore of which has a high zinc content, while production of metallic zinc at the Risdon works continued to increase, despite a cut in the supply of purchased power for a period of two months. Development in the silver-lead-zinc section of Mount Isa Mines has been very important and ore reserves have increased from 9,900,000 to 12,200,000 tons. Exploratory possibilities are such as to stress that Mount Isa is likely to be the greatest lead-zinc field in Australia, as well as the largest copper producer. A great, and very serious problem is the inadequate railway connection between the mine and the Port of Townsville, a distance of 600 miles, both in regard to transport capacity and the actions of the railway's union, which seriously prejudiced the company's operations during the year.

Tin

Tin production continues to be under Australia's needs. The position has been improved by Tableland Tin going into steady operation, but the postponement of completion of the Ravenshoe dredge until purchased power becomes available, and the failure of a Western Australian project, have disappointed expectations of an early, and substantial, increase in output.

Tungsten

Tungsten production was reasonably active and should approximate that of the past two or three years. King Island Scheelite, where flotation is an important part of treatment, and Aberfoyle Tin, had normal output, but the underground position at the latter mine has deteriorated because of the failure to locate ore at the bottom levels, a position that exploration may rectify. What is considered to be the most important tungsten underground mine in the Commonwealth, Storey's Creek, in Tasmania, is to be re-equipped, with a probable increase in output. A substantial tonnage of tungsten continues to come from the Northern Territory.

Aluminium

The plant of the Australian Aluminium Production Commission at Bell Bay, Tasmania, commenced production during the year. The full capacity is 13,000 tons of metal per year, but this may be limited to 10,000 tons for some time by the power position. Overseas bauxite is being treated because of the lower silica content than in local bauxite, which exists in very large tonnages.

Uranium

The early wave of enthusiastic prospecting has subsided, as was inevitable, leaving the field to half-a-dozen prospecting and/or operating organizations. The Commonwealth Government-owned mine and plant at Rum Jungle, Northern Territory, operated by a subsidiary of Zinc Corporation Ltd. on behalf of the Government, is treating its own ore as well as the production from outside groups, which seem likely to become producers of some importance and are planning a joint treatment plant. In Queensland, the Mary Kathleen deposit has been tested by Rio Tinto Ltd., and gives promise of being the largest uranium project in Australia. Ore reserves are not disclosed, apparently for security reasons, and for a similar reason, the tonnages and grade of Rum Jungle and Radium Hill, are not known. The Commonwealth Government has approved a contract whereby the U.K. Atomic Energy Authority will purchase uranium oxide valued at more than £A40,000,000 from the Mary Kathleen leases near Mount Isa. A treatment plant will be erected in the area and production will begin early in 1959 or possibly before. Rio Tinto will provide £2,250,000 towards developing the deposits.

The South Australian Government has brought the chemical treatment plant at Port Pirie into operation, but the cost of this, and of opening up and equipping the Radium Hill mine has exceeded estimates to an extent that seems to have prejudiced the economics of the project This has, no doubt, influenced the attitude of the Government to private enterprise in the uranium industry and the announcement of its intention to pass on the working of the newest discovery, Mount Victoria Hut, to private enterprise. South Australia was the only State to make prospecting and development of uranium a State preserve.

Rutile, Zircon

This branch of mining expanded rapidly during the year, and large areas of country have been pegged, on which examination is being accelerated. Output of rutile for the year will probably reach 55,000 tons and zircon 50,000 tons. Prices for rutile under recent contracts have reached £100 per ton, and higher prices have been given for small, uncontracted parcels. Unfortunately for some producers, old contracts are still in force at prices very much under those now prevailing. The ilmenite of the eastern Australian coast is unsaleable because of the chromium content, but during the year, chrome-free ilmenite deposits were located in Western Australia and will, apparently, meet the requirements of the pigment manufacturers.

Iron and Steel

The Broken Hill Proprietary Co. and its subsidiary, Australian Iron and Steel, have made great advances in output and final figures for the year should approximate 1,800,000 tons of pig iron and 2,200,000 tons of steel. Australian Iron and Steel now has the largest hot strip mill of its type in the world, with a rolling capacity of 2,500,000 tons a year. Ore continues to come from the Iron Monarch, behind Whyalla, South Australia, and from Yampi Sound, Western Australia. There are other iron occurrences, but their disabilities are either size, grade or rail transport. Attention is being given to obtaining ore from New Caledonia. The project of a state iron and steel industry, considered by the South Australian Government, appears to have been abandoned.

Oil Exploration

Disappointment following continued failure by West Australian Petroleum Pty. Ltd. to locate further oil after the very encouraging initial discovery has had a depressing effect on the search. This company is continuing work in the vicinity of Exmouth Gulf, and in the Kimberley country, and has budgeted for an expenditure of £A5,000,000 in 1956. Footage drilled for 1955 may approximate 80,000 ft., and 23 wells have been put down. Drilling has ceased in Queensland. One company is working in Victoria with prospects that appear promising, and showings of oil have been met in a well being drilled in South Australia.

Asbestos

The extensive Western Australian deposits are being worked by Australian Blue Asbestos Ltd. at Wittenoom Gorge. Production has approximated 6,000 tons of fibre and results have been marginal, but improvements in min-

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ing methods and treatment, together with a better overseas market, appear likely to place the industry in a better position.

Sulphuric Acid

The increasing use of sulphuric acid is bringing pyrite resources into expanding prominence. The pyrite mine at Nairne, South Australia, is now producing and delivering mineral to the Port Adelaide acid plant; gases from the updraught sintering plant at Port Pirie will be used for acid manufacture; Mount Morgan is selling increased tonnage of pyrite and pyrite sales form an important part of Mount Lyell's operations. One Western Australian mine, Norseman Gold Mines, operated solely on pyrite required by Perth acid makers.

Coal

Black coal is facing growing competition from oil and the fuel oil by-products of the recently built refineries in Australia. Brown coal in Victoria, is being produced in increasing quantity for generation of electric power and for manufacture of briquettes. Town gas is to be produced from brown coal; the plant at Morwell is nearly ready for operation and the piping of gas to Melbourne.

The Industry's Problems

Shortage of competent labour for the mines is still a retarding factor in progress and recruitments do not meet requirements. The dearth of students taking mining and metallurgical courses at the universities and technical schools is causing much concern in the industry, for the vacancies for technical men greatly outnumber the graduates and diplomates available year by year. The problem of attracting young men to the technical side of the industry is being seriously attacked.

Costs continue to rise and can be countered only by greater efficiency and mechanization. The main factor in costs is wages and, during the past year the steady demand for higher margins above the basic wage for skilled workers. While two Arbitration Courts, Commonwealth and State, function and are in frequent rivalry, there is little hope of wage stability. The abolition by the Commonwealth Court of quarterly increases in the basic wage offered great hopes of stabilization, which were dissipated by the failure of State Courts—and of State Governments—to come into line. Consequently, the upward spiral of costs most uphappily continues.

The Court-imposed lead bonus, based on the price of lead, following Broken Hill practice, is a heavy charge on Mount Isa copper production; the lead bonus must be paid to copper workers, and to all workers in the Mount Isa-Cloncurry district, otherwise no labour would be available to outside mines.

Taxation continues to be oppressive on the industry. Income from gold and uranium is tax-free, and on most other minerals to the extent of 20 per cent. This does not apply to lead and zinc; very large tonnages of low grade material exist, particularly at Mount Isa, the working of which would be practicable with taxation allowances, but as taxation now exists a valuable national asset is likely to be irretrievably lost. Raising the taxation exemption on all minerals would be of inestimable benefit to the industry and the nation.

—And Outlook

The future of gold in 1956 must remain uncertain; the gold subsidy legislation ends in June so prospects are obscure. Copper output may increase slightly to about 45,000 tons, and exceed local demand. The new orebodies at Mount Isa will not be developed to production in the course of the year so their influence on production will not be felt for some time. Provided metal prices hold, lead and zinc output can be expected to rise, but as local consumption may approximate that of 1955, a greater tonnage will be available for export. There are good prospects for a greater output of tin. Iron and steel should exceed the 1955 production but will still be below the rising demand, and by the end of the year, the tin plate mill at Port Kembla will be nearing completion. A big advance is expected in mining and export of rutile and zircon.

NEW ZEALAND

Gold dredging continued during 1955, with three companies producing; a fourth is moving its dredge to another area, which may give substantial life. Since no discoveries of alluvial ground were made, the industry must continue to decline. An occurrence of uranium was reported near the Buller Gorge, but examination of the locality does not seem to have been encouraging, though prospecting for uranium will doubtless be continued. Some experimental work is stated to be in progress on the smelting of the titaniferous iron sands of the West Coast of the South Island, of which there are very large tonnages; these sands might become an important asset if a satisfactory process for treatment can be evolved.

NEW GUINEA

Bulolo Gold Dredging Co. is nearing the end of its career. During 1955, one more dredge was closed down, leaving three in operation, their output being supplemented by hydraulic mining of areas unsuitable for dredging. Production in the last financial year was 14,176,000 cu. yd. for 60,000 f.oz. of gold. New Guinea Goldfields, mainly a lode mining proposition, treated a larger tonnage of ore of slightly lower grade; underground and surface development has been encouraging. Search for oil has been active. A group comprising Oil Search Ltd., Australasian Petroleum Pty. Ltd., and Island Exploration Co. Pty. Ltd., after obtaining encouraging evidence in the Omati bores, decided to spend a further £A3,500,000, and the first bore of the programme, at Kuru, met heavy gas pressure at a depth of 900 ft. A late comer in the field, Enterprise of New Guinea, is now carrying out initial exploratory work on its concession area.

In Dutch New Guinea, a discovery has been made of nickel and cobalt deposits, stated to be large

FIFI

The Loloma (Fiji) Gold Mines is near the end of its ore reserves. Developments at depth, and to the east of the workings of Emperor Gold Mines, appear particularly encouraging. Drilling and other exploratory work have indicated possibilities for important extension of the auriferous region, hitherto considered to be confined to the vicinity of the operating mines. Drilling well to the east of the Emperor Mine has located gold at depth and has given a new concept of the structure of the field. Important orebodies have been intersected by development work in the Emperor Mine, and in the sinking of the internal shaft for their working, encouraging intersections have been made.

The future is quite attractive, but the incidence of taxation has forced both the Emperor and Loloma companies to become holding companies, profits being invested in Australian enterprises. This is one of numerous instances of lack of official sympathy with the mining industry. In the Emperor Mine, open cut ore is nearly exhausted and the future production will be from underground ore, which may be of slightly higher grade. Manganese is now being mined and exported from one of the islands.

The Philippines

THE mining industry in the Philippines prospered in 1955. Outputs of all the principal minerals were higher, and this improvement was paralleled by increased shipments to overseas destinations. Exports of copper concentrates totalled 82,396 l.tons (77,415 tons in 1954), chrome ore 594,936 tons (427,059), iron ore 1,450,881 tons (1,053,336) and of manganese ore 10,741 tons (8,001).

Considerable activity in mining shares was a feature of the year. The biggest single transaction in the history of the Manila Stock Exchange was the transfer of 51,200,000 shares in Consolidated Mines, Inc., a chrome producer located in Masinloc.

PRINCIPAL MINERAL OUTPUTS

	1953	1954	1955
Copper tonnes	12,514	14,349	**17,461**
Chromite ,,	241,000	388,590	**535,262**
Iron ore ,,	1,198,630	1,424,898	**1,432,712**
Lead ,,	2,396	1,827	**2,318**
Manganese ,,	21,168	9,393	**11,912**
Mercury* flasks	—	—	**635**
Gold fine oz.	480,625	416,052	**419,112**

* Five months' operation.

Chromite and Nickel

The Philippines supplied about 30 per cent of all chromite imported into the U.S. in 1955 (1,700,000 s.tons) and 81 per cent of the total refractory grade. Benguet Consolidated Mining Co., operator of the Masinloc mine, expanded its heavy-media plant and has also completed the construction of a railway from mine to port and new loading facilities at the port. The Acoje Chromite Mining Co. has a barter agreement for 70,000 tons of concentrates.

The Palawan Consolidated Mining Co., which was formed in July, 1955 to develop the Irahuan and Sugod mercury deposits in Palawan, expected to start shipping metallurgical-grade chromite in April or May, 1956. The production of mercury began in August last year, and the company is now producing 7.6 tons a month. Blocked-out ore reserves, as of May 31, 1955, were reported to total 135,000 s.tons containing equivalent to approximately 5,100 s.tons of mercury.

The Bureau of Mines has reported the existence of 29,000,000 tonnes of ferruginous laterite and serpentine containing 1.38 per cent nickel on Nonoc Island, Surigao. It has been announced that four North American and two Philippine companies are planning to participate in their development.

The Outlook for 1956

It is expected that in 1956 Philippine mineral production will exceed 200,000,000 pesos in value, representing an increase of at least 30 per cent over 1955. Philippine Iron Mines will increase its output of iron ore by some 500,000 tons yearly. Mati Iron Mines will go into production in 1956, tapping an ore reserve estimated at 1,330,000 tons. Atlas Consolidated is to increase its daily production of copper ore from 6,000 to 10,000 tons. Mindanao Mother Lode Mines expected its copper mining operations at Cabangan, Zambales, to reach 300 tons a day during April, 1956. Masara Mines will have a full year's production in 1956. During its initial operations for a limited period last year it produced 10,534 tons of gold and copper ore.

A new aluminium and foil plant built by Reynolds Philippine Corporation was formally opened in February of this year.

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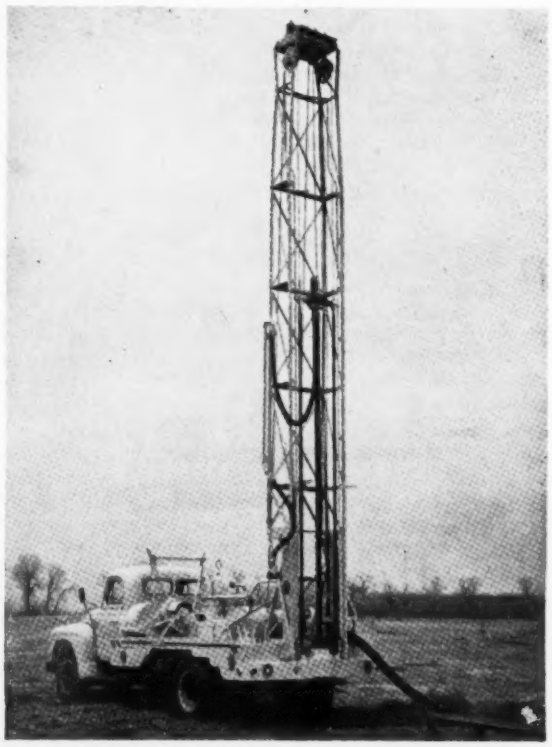

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Japan

BY any standard 1955 was a good year for Japan but, by contrast with 1954 when the policy of deflation was carried through unremittingly, it was extremely successful. Japanese exports became really competitive and the high level of activity in Europe and the United States made it fairly easy to find markets.

At the end of the year the record post-war export total of $2,010,000,000 had been achieved (with December producing a record for any post-war month); imports at $2,476,000,000 still exceeded this figure, but the visible deficit had been cut by $304,000,000. The exports by value of iron and steel and steel goods exceeded those of cotton, while the biggest percentage increase in exports over 1954 by any classification was achieved by non-ferrous metals with the very substantial rise of 59.2 per cent.

Yet the deflationary course had its unhappy aspects. There were prolonged strikes in the non-ferrous metal industry in May and June and at the turn of the year the entire trade union movement was planning a great wage offensive under the leadership of the coal-mining industry.

PRINCIPAL MINERAL OUTPUTS
(in tonnes)

	1954	1955
Aluminium	52,000	**57,515**
Copper, electrolytic	106,478	**113,316**
Lead	34,114	**37,135**
Nickel	2,386	**3,476***
Ferro-Nickel	1,948	**2,614***
Zinc, electrolytic	68,108	**72,678**
Zinc, distilled	32,732	**38,875**
Coal	42,708,000	**42,403,000**

* Estimate based on returns for 11 months.

Copper

The serious weakness of the Japanese industry—its high costs of production—were no problem in a year in which world copper prices rose almost uninterruptedly. But fresh problems arose from the heavy demand for the metal, and the government was hard pressed to reconcile the need for exports and the conservation of foreign exchange with the need for keeping Japanese industry supplied. Thus, early in the year, Japan banned the export of electrolytic copper but at the same time was forced to approve exports to Argentina and Spain n order to preserve export markets for other produce. By the end of the first quarter Japan was obliged to seek imports of copper from the United States—the first copper to be imported since early 1954. The other difficulty that faced the government was that of securing an adequate supply of copper scrap (in 1954 63,455 tons were imported—more than a third more than in 1953). In April, therefore, the Japanese Fair Trade Commission authorized the formation of a scrap cartel to rationalize the import of scrap.

Under the dual price system adopted early this year, Japanese smelters apply the " special price " to about 30 per cent of their copper output to cover the high prices of imported raw materials and domestic copper scrap.

At the opening of the year the domestic price of copper stood at Y.280,000 per tonne; it was raised three times, ending the year at Y.348,000; in January, 1956, Y.348,000 was retained for 75 per cent of output and Y.410,000 charged for the remainder; later this split in the price was widened further. Export prices were, of course, much higher. If copper values decline in 1956—as they seem likely to do—Japanese producers might again be hard pressed.

At the end of April the Japan Mining Company, the largest copper producer in Japan, announced that it had lowered its " special price " for electrolytic copper to 480,000 yen per ton ex-mill from 500,000 yen previously, the " ordinary price " remaining unchanged at 410,000 yen. Other smelters were expected to follow suit.

Nickel

Nickel enjoyed a prosperity as great as that of the copper industry. Japan depends almost entirely on New Caledonia for her supplies of nickel ore. Partly from the sheer pressure of demand, partly by reason of the lowering of the grade of ore exportable, and partly by reason of the interruption of shipping by storms in the summer, it was not easy to keep the capacity always occupied. Nevertheless all the big producers had expansion plans in hand at the close of the year. Shimura Kako is raising capacity from 200 to 430 tons; Sumitomo Kinzoku Kozan from 180 to 250 tons; Nippon Kogyo from 60 to 240 tons; and Kamogwa Kako from 30 to 60 tonnes. The capacity of these firms will therefore rise from 470 to 980 tonnes; it is expected that all being well all these expansions will be completed by September, 1956.

Lead and Zinc

Both lead and zinc production set up post-war records in 1955 and monthly records were set up in December, so that the year ended on a good note. At the same time the Japanese industry is high cost and can hardly expect the same fortune in 1956. It can only advance comfortably under the shelter of continuing world shortage.

Aluminium

Aluminium output was substantially increased last year and the industry had a successful year. All three major refineries—Japan Light Metal, Showa Denko and Sumitomo Chemicals—raised their output and have further expansion plans in hand. It is reported that the Nippon Light Metals Co. is to re-open the plant at Niagata which has been idle since 1954, and this may increase production by a further 20,000 tons a year. Better export and domestic demand and the beginning of Japanese defence expenditure all helped to encourage the industry and prices rose steadily in contrast to 1954. Annual production is expected to reach about 70,000 tons by 1957.

Uranium

By end of 1955 surveying for uranium had been roughly completed and this year should see the start of mining. Traces have been found in a number of prefectures, the most promising finds being at Ogama in Tottori, Myoshi near the city of Kurashiki and Gifu.

Titanium

The Japanese titanium industry has made rapid progress since its emergence some three years ago. Titanium output continues to increase but the target of 10,000 tonnes by the year 1957 seems a long way off. It is hoped to raise production in the next financial year to 2,600 tonnes from an estimated 1,800 tons in 1954-55. The industry is endeavouring to increase sales to the U.S. which takes 90 per cent of Japanese production, domestic requirements being almost insignificant.

Coal

The first part of the year saw the deliberate restriction of output by producers who were anxious to relieve the market of a pressing surplus and end the practice of price cutting that was growing. They were helped by a below-average water supply, which caused a greater dependence on thermal power supplies. As the year progressed they were also helped by the recovery of industry and the consequential greater demand for electrical power. Stocks gradually declined but were still substantial; at the end of the year they were 2,500,000 tonnes. Early in 1956 the coal miners led a strike wave which terminated in a lock-out. The effect was to prune stocks still further, but at the cost of much bad feeling among miners.

Indonesia

THE past year was an important one for Indonesia in that it saw the first election of a Parliament of the Republic. Good progress was made in the fight against inflation; excellent prices were had almost throughout the year for tin and rubber; thanks to a tightening of credit and import restrictions the free market rate of the rupiah improved, reserves increased and the bank note circulation fell. The improvement was most marked during the provisional government of Dr. Harrap. But the increasingly "caretaker" nature of successive governments made it steadily more difficult to reach decisions.

Another difficulty in formulating positive policies was the simple one that the ordinary maintenance of law and order occupied so much time.

Ratification of I.T.A. (and the abrogation of the Dutch connection) was approved by the provisional parliament. Ratification procedure was started in the spring, delayed by a political crisis, and then rushed through in the early weeks of 1956, when it still appeared that the Texas smelter would close in mid-summer. As the possibility of Longhorn staying open till January, 1957, gradually emerged, so it became difficult to find the necessary signatures for the instrument to be deposited in London. Indonesia is undeniably short of dollars and would apparently prefer the safety of the Texas contracts to the freedom of the markets.

The closing of the Texas smelter would, of course, force a change of policy. Whatever their political sympathy, Djakarta and Singapore are totally antipathetic commercially. Indeed, there is no place for an international entrepôt (which reeks of colonialism) in Indonesia's scheme of economic affairs. Nevertheless, with the ending of the Texas contract, the whole of Indonesia's tin output would probably be allowed to go through Arnhem, if only because Indonesia is in a strong position to exert pressure on the Dutch for repayment in part in dollars.

Last year's tin output was down to 33,368 l.tons against 35,861 in 1954. This result was a mixture of unsettled conditions, shortage of equipment, and state interference.

During the year the government issued its plans for "encouraging" foreign investment. Basic services must remain wholly in the hands of the government; "small" industries must be wholly Indonesian owned; "important" industries must be 51 per cent Indonesian controlled; and the "rest" is free for foreign capital. Since 40 per cent of all taxed profits must be deposited in Indonesia for subsequent release for further capital investment, the "incentive" is non-existent.

In these circumstances it is difficult to see how Indonesia's still considerable untapped mineral wealth can be exploited. There are important deposits of nickel at Kolaka in the Celebes that at present prices could be profitably mined. Manganese exists at Kliripan in Central Java but its output has varied enormously from 100,000 s.tons down to only 12,000 in 1954 and forecast of 37,000 in 1955. Output of bauxite rose from 173,000 s.tons in 1954 to 261,372 tons in 1955. Clearly Indonesia would prefer to receive loans of capital equipment, technical services, and technicians to train Indonesians for full control, against eventual repayment in physical mined metal. But in the present Indonesian climate this never wholly attractive outlook seems bleak.

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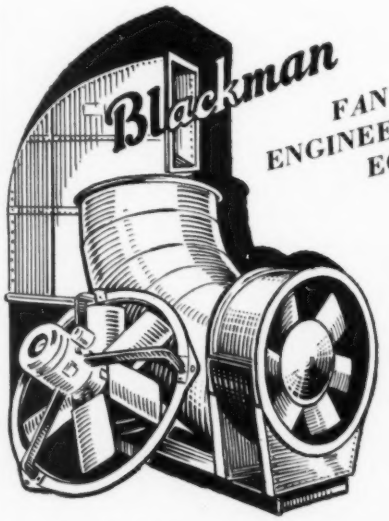

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Malaya

MALAYA prospered in 1955, which was the second best trading year in the history of the Federation, due mainly to the high prices of both tin and rubber. Yet it is for political rather than economic reasons that 1955 was a memorable year in Malayan history, by far the most significant development being the upsurge of nationalism which has swept the Colony within the space of a few months to the threshold of self-government. While the effects of this transformation on the Malayan mining industry are as yet a matter for conjecture, there are some encouraging indications that the new regime will not prove indifferent to the welfare of the Colony's two main sources of revenue.

The drive for self-government gained its first major success early in the year, when Singapore's new constitution took effect. Mr. David Marshall's Labour Front gained an unexpected but sweeping victory and formed a government in association with the Alliance of the United Malays' National Organisation, Malayan Chinese Association and Malay Union. This success was followed by the equally sensational victory in the Federal elections of the Alliance of the United Malays' National Organisation, the Malayan Chinese Association, and the Malayan Indian Congress. The latter result was interpreted by the leader of the Alliance, Tengku Abdul Rahman, as a vote for independence.

No time was lost by the new leaders in visiting London and presenting demands for self-government. At a conference held in January, 1956, it was agreed that the Federation should be given full self-government and independence within the Commonwealth, to be proclaimed, if possible, by August, 1957. This recommendation has received the approval of the Queen. The Federation has undertaken that, so long as a sterling area balance of payment problem remains, it will exercise restraint on its dollar expenditure. Substantial financial assistance will continue to be available from the U.K. Government, and Genku Abdul has stated that foreign investment will be welcomed. Singapore's chances of gaining independence are regarded as favourable. As we write the outcome of the Conference starting in London in April, 1956, is still unknown.

Tin Production

Throughout 1955 the Malayan output of tin-in-concentrates was running at a consistently higher level than in 1954, causing the Department of Mines to revise its earlier forecast of a decline. The final figures show a gain of 555 tons at 61,245 tons. While even this slight improvement is welcome, it is evident that the problem of maintaining output at the present level in the face of diminishing ore reserves must become progressively more acute. In the absence of large-scale prospecting, more economical recovery from low-grade ground may soon become a matter of extreme urgency. Although the problems arising from the operation of the quota scheme under the I.T.A. are still in the future, they too will place a premium on more efficient operation.

According to Malaya's former Chief Inspector of Mines, Mr. G. F. Gripper, who retired at the end of 1955, the mining companies are just keeping their heads above water. It is becoming increasingly difficult for them to get land for fresh operations after working out a section. Some dredges have become "just idle lumps of machinery" because they have no land to work. Stating that there was "little hope of striking any more rich tin-mining land," Mr. Gripper called for more development and suggested working the ground on which the present mining camps round Ipoh are situated. However, he expected the 1955 output to be improved upon this year.

A more optimistic view was expressed by Mr. Ian L. Patterson, Malayan Federation Acting Chief Inspector of Mines, who predicts a healthy future for the industry, based on its greatly increased efficiency. He cannot see Malaya being "mined out" because more than two thirds of the country have yet to be opened up.

It is at any rate certain that the tin mining industry cannot much longer serve as one of the two main props of the Federation's economy, unless government action is forthcoming to lighten its present burden, encourage prospecting, and stimulate the flow of investment capital from abroad. The importance of tin to Malaya is still further enhanced by the far from assured outlook for rubber, the other main prop.

The need for tax concessions to help the economic development of Malaya is evidently accepted by the Federation Government, for the income-tax law has been amended from January 1, 1956, to encourage the development of mines and plantations. The new provisions, under certain conditions, allow abortive expenditure on mining to be deducted.

The production of tin metal in 1955 amounted to 70,631 tons compared with 71,631 tons the previous year. Unfortunately the closing of the Straits Trading Smelter at Pulai Brani in Singapore during the last two weeks of December for routine stock-taking and maintenance coincided with a high level of demand from consuming centres, resulting in an accumulation of ore. The Straits Trading Co. has since brought into operation another smelter at Butterworth, Penang, which will treat some of the ores formerly sent to Singapore.

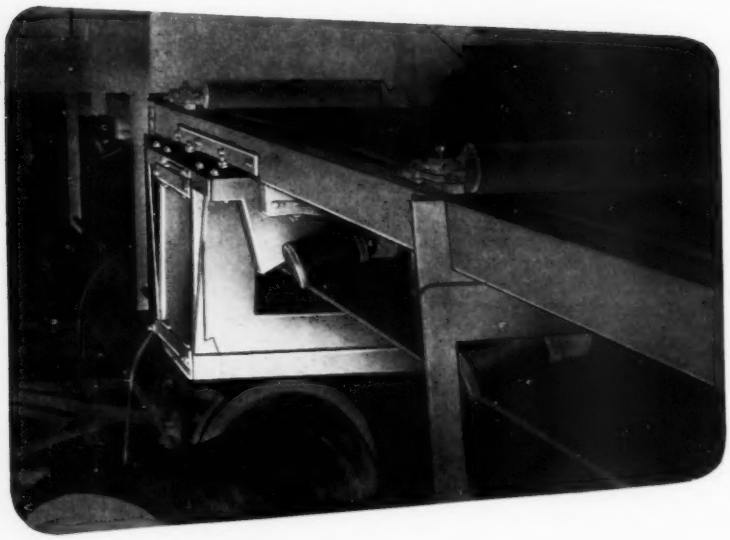
Other Minerals

Bauxite production in Malaya will benefit from a five-year agreement between Ramunia Bauxite Ltd., of Singapore, and South-East Asia Bauxites Ltd., a fully-owned subsidiary of Aluminium Ltd., whereby Ramunia Bauxite will mine, concentrate and treat bauxite ores on a contract basis on behalf of South-East Asia Bauxites Ltd. Seaba have important bauxite mining leases in the south-eastern part of Johore. The quantity to be mined under this contract agreement is 40,000 tons in the first year, but will be increased according to requirements of world markets. This quantity is in addition to Ramunia's own bauxite production, which now averages approximately 200,000 tons per year.

About 750 piculs of corundum—Malaya's newest mineral find—have been dispatched to a firm in California. (This mineral is obtained as a by-product at the Kramat Pulai mines near Ipoh, where it is hand sorted from waste.)

The Outlook

Economically, the omens for Malaya's future under self-government are by no means unpropitious, but there is cause for uneasiness in the undercurrent of labour unrest and racial suspicion. Politically the Alliance is largely a Party of Privilege, which is vulnerable to the forces and emotions inherent in the resurgence of Asian nationalism. The view has been expressed that continued success in the suppression of terrorism might lead the Communists to concentrate their attention on fomenting unrest through the trade unions and particularly in the tin mines. During 1955 there were no fewer than 275 strikes or lock-outs in Singapore, involving 57,433 workers and resulting in the loss of 946,354 man days. Strike action was threatened at the Penang smelter after negotiations regarding rates of pay and conditions of employment had been in progress for several months. It was called off at the eleventh hour, after agreement had been reached on all the men's demands. A deadlock over payment for rest days seemed likely to bring the tin industry to a standstill in February, 1956, but once again a strike which at one time seemed unavoidable was narrowly averted, negotiations being resumed. The opinion that this dispute was primarily a political manoeuvre under communist control was expressed by a number of observers on the spot.



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Pakistan

PAKISTAN'S progress since Partition towards a semi-industrial economy has been highly satisfactory. The setting up of new industries has led to increased activity in exploration and prospecting. By the end of 1954, the total investment in the mining industry amounted to Rs.109,230,000, including over Rs.80,000,000 by oil companies. The Government is reported to be considering the formation of a Bureau of Mines to co-ordinate the work of existing organisations dealing with mines and minerals. In its programme of minerals development it is being assisted by Mr. John L. G. Weysser, a highly qualified mining engineer, whose services were acquired through the U.S.A. Mr. Weysser will make a general survey of the mining industry in Pakistan.

The key to Pakistan's future development is power. By 1965 the country's power requirements will be of the order of 1,000 mW, while the total generating capacity possible by that date is only 800 mW. In the cirumstances the Government is considering the establishment of a Commission to prepare plans for a survey of atomic raw materials and the installation of research and training reactors. The U.S. is to contribute $3,500,000 towards the cost of a dam and power station on the Karnafuli River near Chittagong, which will double East Pakistan's present power output of 60,000 kW. The dam is scheduled for completion in 1959 and will cost $65,000,000.

An important project completed in 1955 was the Sui gas scheme, for which a £5,000,000 loan was made by the World Bank in June, 1954. On November 9 the Governor-General of Pakistan formally opened a 350-mile pipeline bringing natural gas to the Karachi area in West Pakistan from the Sui-oilfield. In the first year of operations this pipeline will save Pakistan from importing $3,000,000 worth of fuel from overseas; this saving will increase in later years to an annual rate of $12,000,000. A new gas pipeline 60 miles long connecting the Dhulian field with Rawalpindi was also completed last year.

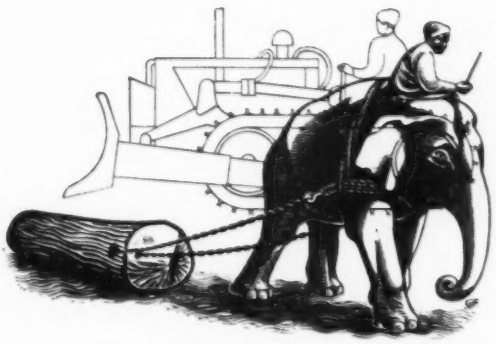
Chromite deposits occur in the Hindubagh area of Baluchistan. Several firms are engaged in chrome mining and a considerable number of new mining concessions for chromite have been granted. Production rose last year to about 30,000 tons compared with 21,865 tons in the previous year. Rich deposits of chromite and manganese were recently discovered in the Kalat division of West Pakistan. The manganese is located about 18 miles east of Lasbela, while the chrome exists at various places in the Rasko range, Kharan district. Plans for development of the deposits have been approved and work will start shortly. The manganese deposits will be worked by the Mining Department of the Baluchistan States Union, while the chrome deposits may be leased to private industrial firms.

Deposits of antimony occur in Chitral. These were worked during the second world war, but operations were abandoned on Partition. A mining lease for antimony has recently been sanctioned.

A sulphur purification plant under construction in Quetta is said to be the first of its kind in Baluchistan. When in full operation, it will meet the entire demand for purified sulphur in Pakistan. Production was expected to start early in 1956.

The Pakistan Industrial Development Corporation and the West German firm of Krupps were reported to have reached complete agreement over the setting up of an iron and steel plant in the Multan district.

Coal production rose steadily from 30,000 tons in 1949 to 560,000 tonnes in 1954 and 580,000 tonnes in 1955. The Government has undertaken to work some collieries in order to obtain first-hand knowledge of costs and problems.



It is impossible to judge from statistics alone how far India's *traditional industries are being reshaped* by Western machines and methods. A first hand experience of Indian life and commerce, like that of the National Bank of India, is needed to put facts into perspective. Enquiries about trade here, or with any other country which is served by the Bank, are welcomed at the Head Office or at any branch.

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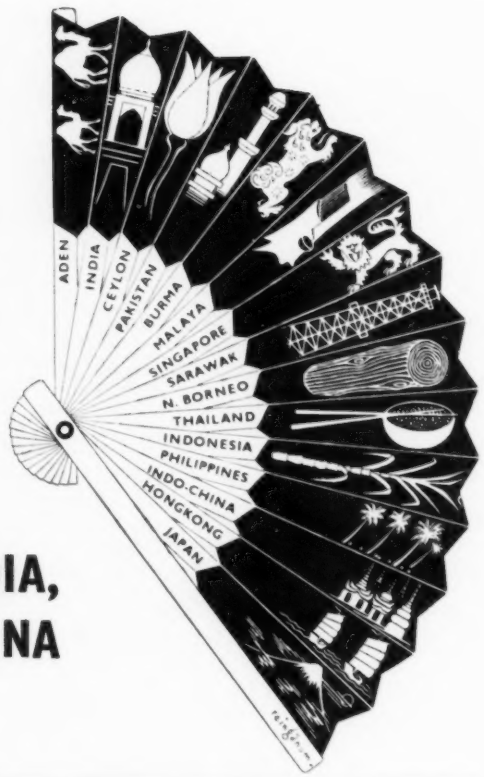

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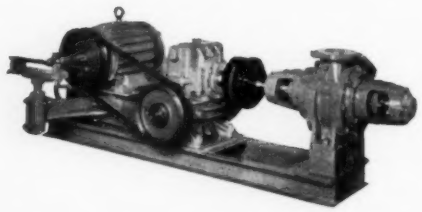

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India

FOLLOWING detailed examination by States and Government Departments, India's Second Five Year Plan has been expanded, principally by increased provision for railways. Total Government expenditure on the Plan is now estimated at Rs. 4,800 crores compared with Rs. 4,300 crores in the original Plan frame. This will mean foreign assistance to the extent of Rs. 160 crores a year, or about three times the rate at which such assistance has been received in the past few years. The expansion of the steel industry and the development of non-ferrous resources are key factors in the Plan, with its emphasis on heavy industry. Associated Electrical Industries have been appointed to act as consultants in a major project to create a heavy electrical manufacturing industry.

A Ministry of Iron and Steel was set up in 1955 and will administer the three steel plants being erected with U.S.S.R., German and British aid. Technicians from the U.S.S.R. and representatives of Krupps-Demag arrived in India at the end of the year with final reports for the respective plants, each of which will be of 1-million tons capacity. A consortium of British firms, called the Indian Steelworks Construction Co., is to build the third plant at Durgapur in West Bengal, the estimated cost being £80,000,000. In addition to the target of 3 million tons to be produced by these three plants, India proposes to increase iron and steel production by 1,585,000 tons to 3,181,000 tons annually by 1961. As part of the expansion programme the Tata Iron and Steel Co. have concluded arrangements to raise production at their Jamshedpur works from 1.3 million to 2 million ingot tons. They also have in hand a project for a new ferro-manganese plant designed for future expansion to 100,000 tons per annum. At present Tata produces 15,000 tons of ferro-manganese per annum. The Government proposes to raise the country's total installed ferro-manganese capacity to 160,000 tons by 1961.

Meanwhile India is seriously short of steel. Controls have been re-imposed over certain types of structurals and scrap with effect from November 15, 1955. The possible purchase of 1 million tons of steel from the U.S.S.R. over the three years 1956-58—as well as oil, mining equipment and other goods—was among the subjects discussed during the visit of Marshal Bulganin and Mr. Khrushchev. China, itself short of steel, has offered India 60,000 tons.

Oil, Diamonds and Gold

A team of Russian oil and mining experts arrived during November, 1955, on the invitation of the Government of India. The oil experts toured Assam, Bihar, West Bengal and the U.P. in connection with prospecting, while mining engineers visited the Panna Diamond Mines in Vindyha Pradesh. It was reported that the team might investigate the possibility of setting up manufacturing units for petroleum drilling rigs and mining equipment.

The Indian Government has announced its intention to nationalize the Panna diamond mines. At the time of writing nationalization of the Kolar goldfields is still under discussion.

Since the closing down of Ooregum, gold production has been confined to Champion Reef, Mysore and Nundrydroog, whose aggregate output declined to 199,930 oz. (219,764 oz. in 1954). Details : Champion 61,167 oz. (69,571), Mysore 62,432 oz. (79,254), Nundydroog 76,331 oz. (71,941).

Coal

The Government of India is also negotiating with the U.S.S.R. to obtain technical experts and equipment for the exploitation of 15 million tons of coal. East Germany, Poland and the U.K. are among other countries with which talks are likely to be held for the same purpose. It has been roughly estimated that India would require equipment worth about Rs. 500 million to reach the target for coal production envisaged in the Second Five Year Plan. Mr. R. S. Krishnaswami, formerly Director-General of Food, has been appointed India's first Coal Production Commissioner. The existing Coal Board will, in future, deal only with control and distribution.

While the Government cannot give a guarantee that the coal industry will not be nationalized, it has assured the industry that, if private collieries are nationalized, special provision will be made for compensation for any development work which has been undertaken. Private collieries will be restricted to working their existing pits and contiguous areas and will not be allowed to sink completely new shafts.

Non-ferrous Metals

With the help of the Government, the recently formed Bombay Metal Exchange proposes to set up a corporation for prospecting mining possibilities in India. One of its aims is to achieve "near self-sufficiency" in non-ferrous metals, particularly copper and lead. No possibility of mining zinc and tin in India is foreseen.

The aluminium industry is to be protected for another three years, in accordance with the Tariff Commission's recommendations. Imported aluminium in crude or manufactured form will continue to be subjected to a duty of 30 per cent *ad valorem*, plus 5 per cent of the duty. Plans for the construction of a smelter at Hirakid capable of producing 10,000 tons of aluminium annually have been announced by Aluminium Ltd. The smelter, which will double India's present aluminium production by 1958, will be patterned on Canadian plants and will involve a capital investment of some $15,000,000. It will be capable of expansion to 20,000 tons annually.

Mica, Manganese and Chrome

Postponement of the mica stockpile by the U.S. has resulted in a sharp set-back for Bihar's mica export trade. It was reported in December, 1955, that some U.S. mica importers had cancelled orders with Giridiah and Kodarma merchants, with the result that stocks of mica splittings, condenser films and blocks had started to accumulate. These adverse trends may hasten the setting up of the Mica Export Promotion Council. Mica exports are believed to have figured in the Indo-Soviet talks at New Delhi.

The improved market for manganese ore led to the re-opening of mines which were closed when prices dropped. Production figures for 1955 are not yet known, but exports were at a minimum of 700,000 tons against 632,370 tons in 1955. The heavy media separation plant at Dongri Buzurg is operating satisfactorily and several of the larger mines have been connected to the system. Rail transport is still not very satisfactory, but is understood to be improving.

The Government of India are regulating exports of chrome ore during 1956 on a quota basis, through shippers who had exported the ore during any of the three calendar years 1953, 1954 and 1955. During the period Jan.-Oct., 1955, India shipped 279,864 tons of ilmenite to the U.S., against 168,275 tons in the corresponding period of 1954.

The programme of the Geological Survey of India for 1955-56 includes a geological reconnaissance of the Andaman and Nicobar Islands and a geological expedition to the Garhwal Himalayas. In Andhra State, a geophysical survey, utilizing electrical and magnetic methods, has been proposed for the exploration of copper deposits in the Guntur district.

Cyprus

OVERSHADOWING all other events in Cyprus during 1955 was the dispute which has arisen over the island's political future. Britain at present rules Cyprus as a Crown colony and has been largey responsible for the expansion of its mining industry. For several reasons growing difficulties have resulted from the Greek-supported demand by a large number of Cypriots for Union with Greece. The deadlock which arose last year led to disturbances and terrorism and in order to restore internal order Field-Marshal Sir John Harding was appointed to be Governor and Commander-in-Chief of Cyprus. Negotiations proved fruitless and since the deportation of Archbishop Makarios they have not been resumed.

The increasing importance of the mining industry to the economy of Cyprus is evident from the fact that the value of mineral products exported during 1955 rose to the record figure of £10,114,306 from £9,575,621 in 1954. The latter figure was equivalent to 59 per cent of the total value of all the island's exports. While this further increase in the revenue from mining is attributable in part to the higher price of copper, it is noteworthy that in January, 1956, the average number of workers employed on mines was 6,156, which compares with 4,942 in January, 1955, and 4,824 in January, 1954. Though increased mechanisation has resulted in an appreciable reduction in the number of persons employed at Amiandos Mines Ltd., this has been offset by the higher labour requirements of the Hellenic Mining Co. and Cyprus Sulphur and Copper Co.

MINERAL EXPORTS
(tons)

	1954	1955
Iron pyrites	687,954	**753,700**
Cupreous pyrites..	125,370	**133,640**
Cupreous concentrates....	93,610	**77,765**
Copper cement....	3,060	**2,850**
Asbestos	21,403	**12,843**
Chromite	9,867	**8,570**

Under favourable conditions exports of copper and sulphur-bearing products seem likely to continue trending slightly upwards. By the end of 1954 the Limni treatment plant of the Cyprus Sulphur and Copper Co. Ltd. had been brought into operation, while orders had been placed by the Hellenic Mining Co. Ltd. for the necessary equipment to allow for transfer of the company's main operations to the Mitsero Agrokipia area. Extensive prospecting operations in the latter area during recent years have disclosed sufficient reserves of iron pyrites to warrant the installation of a modern treatment plant of 720,000 tons per annum throughput.

During the nine months to December 31, 1955, Cyprus Sulphur and Copper mined 36,720 tons from the Kinousa section and 90,510 tons from Limni. Output from Limni was curtailed by a shortage of excavating equipment and modifications to the milling plant. A new 1½ cu. yd. excavator was installed. There has been considerable improvement in the working of the Limni mill. It is considered that the mill should now be able to treat a total feed of at least 13,000 tons per month and obtain a pyrite concentrate containing not more than 0.2 per cent copper. A new unit is being added to the slimes flotation plant. The opening up of further areas around Kinousa is regarded as highly important, but much work will be necessary before future potentialities can be accurately assessed.

The Geological Survey has continued the detailed mapping of igneous rocks in which the known orebodies occur.

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Turkey

MINING and industrial production in Turkey expanded during 1955. Comparison of the first nine months of 1954 and 1955 shows increases of 31 per cent in chromite production (531,520 tons in all 1954), 13 per cent in lignite, and 40 per cent in iron ore. There were decreases of 5 per cent in coal (due to floods at Zonguldak) and 9 per cent in copper. Production of quicksilver in 1955 was estimated at 8,000 kg. Sulphur production was in the region of 20,000-25,000 tons.

The Changing Structure of Turkish Mining

The law governing the operations of the Central Bank, which is the controller of Turkey's credit mechanism, has been amended to provide facilities for individuals and firms engaged in mining and industrial enterprises, but the persistent trade deficit makes equipment difficult to obtain. The State economic establishments are going into partnership with new enterprises formed both with foreign and domestic private capital.

Thus the Karabük iron and steel plants, which are being greatly extended, have been separated from the Sümerbank and converted into independent State enterprises. A Bill to separate the Eregli coal mines and western lignite mines from the Eti Bank and convert them into independent enterprises is to be presented to the Grand National Assembly. The Ministry of State Exploitations has been replaced by a Ministry of Mines and Industry.

Eti Bank's Divrik iron mines have been merged with Sümerbank's Karabük steel works to form the Turkish Iron and Steel Works Co. Representatives of the German firm of Krupp have signed an agreement with the Turkish Iron and Steel Works and the Turkish Government to form a company known as Mines Exploration and Investigation Co. Starting with Western Turkey, iron ore deposits will be investigated with a view to the establishment of a second steel industry with Krupp's participation.

Krupps have sent two geologists to study deposits of tungsten ores in the Ulu Dag mountains, where the Turkish Mining Institute is reported to have proved the existence of about 6,000,000 tons of ore averaging 0.48 per cent WO_3. Wolfram deposits found near Brussa have been described by President Bayar as the fourth largest in the world. They will be worked by the Eti Bank.

Chrome Has a Difficult Time

Despite the reported increase in production, chrome mining has been under a cloud since 1954, when exports declined very steeply. In October, 1955, it was reported that no contracts could be concluded because the mines were short of explosives, while road transport was precluded by the scarcity of tyres for lorries. Due to the shortage of spares and tyres for road transport vehicles, transportation costs have been almost doubled since 1954.

There has been a considerable revival in commodity deals with Turkey. Special purchases of Turkish copper, chrome and barley exceeded £1,400,000. Other deals are reported to be under consideration. Regular repayments of Turkish commercial debts began in October and November and have continued at roughly £130,000 a month. By the beginning of March, 1956, Turkey had repaid £1,500,000, being the amount which the country had in fact promised to pay off in the course of 1955.

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Greece

THE Greek industrialisation and investment programme, as announced on June 21, 1953, by M. Markesinis, then Minister for Co-ordination, gives considerable prominence to more intensive development of mineral resources.

Important Lignite Developments

The principal mining project is the development of the Ptolemais lignite deposit, with reserves conservatively estimated at some 250,000,000 tons. The Ptolemais lignite area is located in Western Macedonia, some 23½ miles north of the town of Kozani, on the new railway connecting that town with Florina in the north. West German industrial interests, headed by Krupps, are partners in a group which is to succeed Hellenic-American General Lignite Products Co., Inc., the original concessionaires. Besides the development of the actual mines, the scheme envisages the erection of a briquette works, carbonising plant, and nitrate fertilizer plant, as well as a thermal power station of 65,000—85,000 kW capacity burning lignite. The expenditure involved is estimated at $20,000,000.

Nickel

The Larymna nickel mines on the mainland coast north of Athens are the subject of another scheme included in the industrialisation plan. The ore averages 1 per cent nickel content with a maximum of 3 per cent. A new plant for processing 130,000 tons per annum was supplied by Krupps in 1953. This firm is again instrumental in a scheme providing for the further development of these old mines (opened in 1909) and for the supply of a modern smelter. Over 80,000 tons of nickel ore were mined in 1955, the bulk of the nickel being exported to Western Germany either as ore or in the form of metal.

Efforts to locate mineral oil deposits in Greece have so far proved unsuccessful, but prospecting is still being carried on in Epirus and the Peloponese. On Zakynthos Island, in the Ionian Archipelago, a Greek-American group is about to start drilling operations.

MINERAL OUTPUT AND EXPORT
(tonnes unless otherwise stated)

	1954	**1955**
Lead metal	2,876	**2,724**
Silver, oz.	70,200	**64,500**
Bauxite	280,000	**450,000**
Nickel ore	—	**80,000**
Magnesite	—	**100,000**

Other Minerals

Rich deposits of bauxite occur in various parts of Greece, but this wealth, too, needs to be developed. Greek bauxite has been mined since 1935, the 15 most important mines (at present being worked to 80 per cent of capacity) being situated near Eleusis on the coast, some eight miles west of Athens. In July, 1955, it transpired that Vereinigte Aluminiumwerke, jointly with a Swiss aluminium group, had purchased from Canadian owners three bauxite mines near Delphi which had not been worked since the war. Lack of electric power has prevented Greece from establishing an aluminium industry.

The output of lead and silver by Compagnie Francaise des Mines de Laurium has been stablised in recent years. Nothing further has been heard of uranium deposits alleged to have been located in Western Thrace in 1953, nor of a rich deposit of manganese ore reported in 1954 from Andritsemis (Patras province) in northern Peloponese.

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Yugoslavia by E. A. BELL

INDUSTRIAL production in Yugoslavia in 1955 exceeded the level recorded in 1954 by 13 per cent, and was thus one per cent higher than the target figure envisaged by the Social Plan for 1955. Both mine production and prospecting activities, as a whole, were greatly intensified in 1955.

Coal and Coke

The output of coal aggregated 15,200,000 tonnes in 1955, exceeding the 1954 level by more than 11 per cent. The increase of 1,537,000 tonnes was, in fact, the largest annual expansion reached in Yugoslav coal mining since 1945, lignite (840,000 tons higher) accounting for the bulk of the increase. Despite this, and owing to the increased demand deriving from the rapidly expanding industry, less coal was available for export (chiefly to Italy). The increase came mainly from Slovenian lignite and brown coal.

Since the first coke ovens of the country were placed in service at Lukavac (north-eastern Bosnia) 3 years ago experiments have been going on to find a satisfactory blend of home-produced brown coal with imported high-grade coal, which would yield a satisfactory type of coke. It appears that these efforts have been successful. In 1955, the production of coke soared to 720,000 tons, that is nearly double the total attained in 1954, and it is said that the new coal blend will result in reduced importation of coking coal, thus saving $7,000,000 annually.

MINERAL AND METAL OUTPUT
(tonnes unless otherwise stated)

	1954	1955
Coal	13,663,000	**15,200,000**
Coke	380,000	**720,000**
Crude oil	216,272	**258,000**
Butane and propane	880	**1,748**
Methane (cu. m.)	90,130,000	**105,000,000**
Pig iron	356,000	**514,228**
Steel, ingot	616,000	**798,677**
Bauxite	686,689	**794,619**
Aluminium, ingot	3,496	**11,400**
Refined lead	66,729	**75,615**
Copper	30,100	**28,100**
Magnesite, crude	108,018	**140,000**
Asbestos	3,264	**2,945***
Mercury (metal) (s.tons)	547	**553**

* January to September, 1955, only.

Iron and Steel

The increased production of coke had a beneficial effect on the iron and steel industry, which achieved record results in 1955. The output of pig iron rose from 356,000 tonnes in 1954 to 514,228 tonnes and that of raw steel from 616,000 to 798,677 tonnes. Although the iron ore mines near Vares (to the north of Sarajevo) doubled their output in the course of 1955 to nearly 1,000,000 tonnes, the demand for iron ore has grown to such an extent as to make importation unavoidable. Before the end of the year an agreement concluded with India provided for a first shipment of 10,000 tons of Indian iron ore. If this proves suitable, larger quantities of iron ore will be placed on order in India.

The Vares region is believed to contain 160,000,000 tons of iron ore, while reserves in the Ljubija basin have been calculated at 200,000,000 tons. Extensive deposits of ferrous bauxite, amounting to some 5,000,000 tonnes, were discovered a few months ago in eastern Bosnia, between Srebrnica and Vlasenica, a few miles to the south of the town of Zvornik on the borderline with Serbia). This type of bauxite has a high Fe-content and no manganese and is said to be most suitable for the production of grey iron, which Yugoslavia is still importing.

Mercury

The output of mercury metal reached 553 s.tons in 1955, compared with 549 tons recorded for 1954, and 90 per cent. of it was exported. Preparations are in hand for an increase in the output of mercury ore by 50,000 tonnes p.a. to 190,000 tonnes since mercury ranges high in the list of export articles earning dollars and other hard currencies. The value of the mercury exported in 1955, at between 700,000,000 and 800,000,000 dinar, represented approximately 1 per cent. of the country's total revenue from exports in 1955 (73,440,000,000 dinar).

Mineral Oil

The production of crude oil expanded considerably in 1955, but covers only about a third of the country's requirements of oil products, and increasing quantities (136,000 tonnes) of crude were imported from the Soviet Union in 1955, in addition to 4,000 tonnes of aviation petrol (100/130 octane) and other derivatives. For 1956, the production of crude has been set at 325,000 tonnes, and the combined throughput capacity of the three refineries (Rijeka, Sisak, Bosanski Brod) is to reach 800,000 tonnes in 1956. A fourth refinery is building; it is to be put on stream in 1956, adding a further 150,000 tonnes.

Nuclear Research

The three nuclear research instiutes in Yugoslavia at Belgrade, Zagreb and Vince (Slovenia) have intensified their exploratory activities in respect of uranium throughout all Bosnia - Hercegovina Montenegro, Slovenia and Macedonia, the five republics said to offer the greatest likelihood of uranium ore deposits. Uranium ore 232 has been located in some 200 places. In addition, thorium, barytes, titanium and titanium-magnesite are said to have been discovered.

Bauxite and Aluminium

The output of bauxite reached the record level of 794,619 tonnes in 1955, this being about 16 per cent more than in 1954. The production of aluminium ingots in 1955 was more than three times the total recorded in 1954.

Copper and Lead

Yugoslavia is Europe's second largest copper producer (after the Soviet Union) and ranks ninth amongst the world's copper suppliers. The 52-year old Bor copper mine and copper industry works (eastern Serbia) has produced about 1,000,000 tons of pure copper since the start of production and experts have calculated that reserves at Bor still total some 40,000,000 tons of copper ore, though of a low-grade quality. It is intended to maintain an annual output of 30,000 tons of pure copper at Bor, but to do so the ore must be enriched by high-grade copper ore which is to be obtained from the Majdanpek mine some 20 miles to the north of Bor. A large refining plant and a sulphuric acid works are to be erected at Majdanpek with American financial aid, repayment to be made in the form of copper. The development of the copper converting industry has resulted in the gradual reduction of exports of blister copper from 21,000 tonnes in 1948 to less than 5,000 tonnes in 1955.

The new refining and electrolysis plant at Trepca, Europe's largest lead combine (about 77 miles to the north of Skopje, the capital of Macedonia), which opened in spring, 1955, enables all lead ore mined in Yugoslavia to be processed in the country. The capacity of the new electrolysis plant in respect of fine silver is 264,000 lb. p.a.

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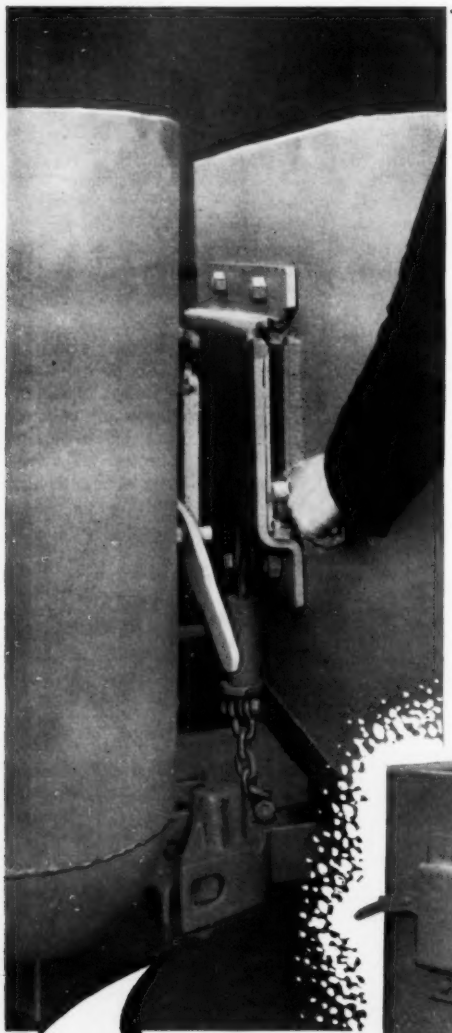

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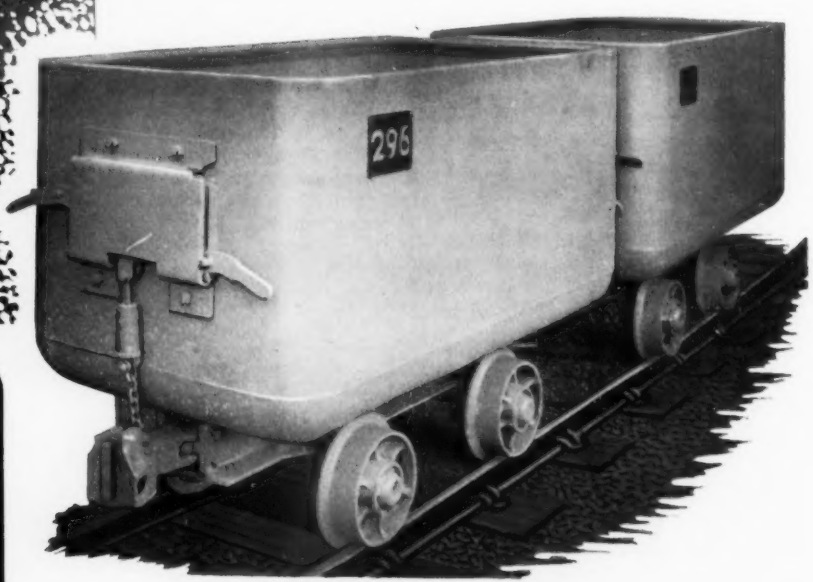

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Italy

THE year 1955 was a very satisfactory one for Italian mining. Considerable increases in the output of most branches of the mining industry were recorded, and in a number of branches war-time peaks reached under pressure of conditions then prevailing were exceeded. These results were part of the outcome of the Italian ten-year plan for economic development ending in 1964 and known as "Piano Vanoni". According to this plan, income derived from mining and quarrying in Italy should by 1964 be approximately 120,000,000,000 lire higher than the figure for 1955.

Methane

The output of methane in 1955, at 3,300,000,000 cu. m., almost all of which came from the central and eastern regions of Northern Italy, was again a notable record, being some 33 per cent in excess of the 1954 result. The length of the methane pipeline system reached 2,449 miles by the end of 1955, as against 2,117 miles a year previously, and more than 1,800 industrial undertakings throughout Northern Italy operate on methane, having totally discarded coal as a source of energy, and in part, also electric power. Two ambitious schemes for the supply of methane to Austria and to Southern Germany by pipelines crossing the Alps were evolved in 1955.

Coal

Despite methane's encroachment upon the use of coal in industry the supply position as to coal showed critical aspects at times in the course of 1955. This was an outcome of the rapid expansion of industry generally, and of heavy industry in particular. Coal mining in Italy produces annually about 2,000,000 tonnes of brown coal and lignite including some 60,000 tonnes of anthracite from the La Thuile mine in the Aosta Valley, Italy's only anthracite mine. One million tonnes of lignite originates from the Sulcis basin in south-western Sardinia, while requirements, all told, aggregate some 11,000,000 tonnes p.a.

Preparations are in progress to work the lignite deposits near Perugia for which a German group is to supply machinery and plant. The thorny problem of the extremely uneconomic production of the Sulcis lignite was solved in 1955, thanks, in part, to the intervention of the European Coal and Steel Union. All uneconomic mines of the Sulcis basin have been closed down and mining concentrated in the Seruci area, which is better equipped and more promising. Output at Seruci is to be increased by 100,000 tonnes p.a. which will reduce costs.

Mineral Oil

A highly productive oil deposit was discovered near Alanno, in the Abruzzi mountains, some 18 miles to the west of Pescara, a port on the Adriatic coast. The concession is owned by Petrosud, a company jointly (50 : 50) formed by Montecatini and the Gulf Oil Corporation. Regular production at Alanno started later in 1955 and the daily average from two wells is 600 tons of crude. The Alanno production has been instrumental in increasing Italy's output of crude oil from 86,600 tons in 1954 to 204,000 tons in 1955, the concessionaires being Gulf Oil. The production capacity of the eight wells of the Ragusa concession is said to total 275,000 tons p.a.

Much indignation has been roused by the new oil bill submitted to Parliament in autumn. Royalties are foreseen at 60 per cent of the profit, and there are additional taxes and fees. Moreover, a certain percentage of the crude produced must be surrendered to E.N.I. (or to its associates). Pending passing of the Bill, the Government has blocked the granting of further oil prospecting and drilling concessions.

Uranium

From a report by Professor D'Ippolito, a member of the Italian delegation to the Atomic Conference in Geneva last year, it appears that there are good prospects for uranium mining in various regions of the country. Uranium ore has been located mainly at Peveragno (near Cuneo, to the south-west of Turin) and in the Alps to the north of Milan. The coastal sands near Nettuno (south-west of Rome) are reported to contain 440,000 tons of thorium oxide with an average of 60 gm. of thorium per ton of thorium oxide. Prospecting is being carried on in the Maritime Alps near Ceva (to the south of Turin), in Calabria, and is soon to start in Sardinia.

METAL AND MINERAL OUTPUT
(Tonnes unless otherwise stated)

	1954	1955
Natural gas (000 cu. m.)	2,458,000*	**3,300,000***
Crude oil extracted	86,600	**204,000**
Refining capacity†	22,000,000	**28,000,000**
Pig iron	1,300,000	**1,600,000**
Steel, ingot	4,500,000	**5,500,000**
Bauxite	295,082	**360,000**
Aluminium	57,580	**61,700**
Lead ore	69,125	**80,000**
Lead, ingot	37,331	**40,750**
Zinc ore	128,111	**129,862**
Zinc, ingot	67,455	**69,920**
Manganese ore	48,846	**60,000**
Sulphur (raw, molten)	200,000	**180,000**
Arsenic‡	2,019	**2,407**

* 1 cubic metre = 35.317 cu. ft.
† At the end of the year. ‡ First seven months.

Mercury

British purchases of Italian mercury were at a particularly low level in 1955, while orders from the U.S., formerly the best customer, ceased altogether. The output of mercury metal totalled 883 tonnes in the first half of the year as against 870 tonnes in the corresponding period of 1954, but exports during the same period dropped to 524 tonnes—two-thirds less than the 1,582 tonnes which were exported in January - June, 1954.

Bauxite and Aluminium

The output of bauxite, at 360,000 tons, was 20 per cent higher than in 1954, and originated in the main from mines in the Gargano peninsula and near Lecce (both on the Adriatic) and from the Abruzzi deposits. In the Abruzzi, a new bauxite deposit at Molina Aterno, in Aquila province, is now being worked. The production of aluminium rose to 61,700 tonnes from 57,580 tons in 1954, but exports dropped to 5,988 tonnes (10,223 tonnes).

Iron Ore, Steel and Sulphur

The output of iron ore in 1955 at 890,000 tonnes was about the same as in the previous year;500,000 tons came from the Elba deposits, 270,000 tonnes from the Aosta mines (Cogne), 25,000 tons from the Traverselle region (near Ivrea in the Aosta Valley), while 95,000 tons was extracted from the Alpine deposits to the north of Brescia where reserves total 8,760,000 tonnes (35-40 per cent Fe). Big schemes are in view to increase Italy's iron ore output to an annual 1,900,000 tonnes by 1957, mainly through tapping as yet unused reserves in Sardinia. Iron and steel production reached nearly 5,500,000 tonnes of steel ingots and 1,600,000 of pig iron (4,500,000 and 1,300,000 in 1954). In Sicily, production of molten sulphur in 1955 exceeded 180,000 tonnes and that of ground mineral sulphur totalled 21,000 tons.

Spain

IMPRESSIVE progress was made during 1955 in the expansion of Spain's mining and metal industries. Substantial improvements have been recorded in the outputs of nearly all the principal ores and metals. The Government's efforts to encourage the development of basic industries are also reflected by the construction of new smelters and treatment plants and the extension of existing plants, which should lead to further advances in 1956.

As can be seen from the table, the production of iron ore rose to a new and, considerably higher peak. Contracts have been signed for the supply of 1,015,000 tonnes of Spanish iron ore to Germany during 1956 at prices reported to be 10-11 per cent above those for 1955.

Exports of Spanish pyrites in 1955 amounted to some 1,560,000 tonnes as compared with 1,490,000 tonnes in 1954. Internal deliveries in 1955 at about 680,000 tonnes showed an increase of about 90,000 tonnes on 1954.

METAL AND MINERAL OUTPUT
(in tonnes)

	1954	1955
Ores		
Iron	3,877,700	**4,766,083**
Pyrites	1,919,675	**2,014,600**
Coal	14,152,000	**14,213,097**
Zinc	148,410	**164,839**
Magnesite ...	50,034	**40,319**
Fuorspar	205,507	**201,840**
Metals		
Iron (ingot) ..	836,000	**963,954**
Steel	1,083,630	**1,211,388**
Copper	26,371	**21,372**
Zinc	22,843	**23,268**
Lead	56,677	**63,405**

The production of quicksilver is being expanded by the construction of a new cinnabar distillation plant at Mieres in the province of Ovieda. The plant, which will be equipped with a multiple bottom furnace of Spanish construction, is expected to be ready for operation by the end of 1956. The raw materials, cinnabar and arsenious ores, will come from the nearby La Peno mines. Increased production is also expected from the sinking of the new San Joaquim shaft at the Almaden cinnabar deposits.

Coal production at 14,213,097 tonnes was slightly higher than in the previous year, while increased prices led to an improved quality in the products of washing plants.

Substantial gains were recorded in nearly all branches of the non-ferrous metal industry. The output of aluminium more than doubled in 1955, due partly to increased production by the state-owned Empresa Nacional de Aluminio, of Valladolid, which has been authorized to increase its capacity to 10,000 tons a year. Aluminio y Aleaciones, S.A. has applied for Government permission to open up an aluminium processing plant at Sabinanigo in Huesca province.

Annual capacity will be 45 tons of refined aluminium ingot, 480 tons of aluminium foil, and 72 tons of aluminium paste, all raw materials being of Spanish origin.

Minera Celdran S.A., a mining firm of Cartagena, province of Murcia, has been authorized to build a smelter capable of treating 40,000 tons of zinc blende per year. The company hopes eventually to produce 18,000-20,000 tons of electrolytic zinc annually.

A factory to produce 20,000 tons of sulphur annually has been opened at Hinogedo, near Torrelavega.

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Portugal *by Our Own Correspondent*

EXPORTS of most mineral products were at a higher level during 1955 than in the previous year, as the accompanying table shows. Substantial improvements are recorded for cupreous pyrites, iron ores (haematite and magnetite), manganese, tungsten ores and white arsenic. On the other hand, the production of cassiterite was on a considerably reduced scale, while that of tin metal fell to 157 tonnes from 367 tonnes in 1954.

It should be pointed out that the tonnages given for WO_3 ores include about 500 tonnes of residues, some of which contain considerable percentages of cassiterite. Exports of tin slag are not attractive unless the price of tin is equal to or above £825.

Despite fluctuations in the wolfram market the operations of leading producers showed satisfactory margins of profit, high grade Portuguese concentrates as usual commanding a premium in world markets.

At the time of writing official production figures are only available for January-October, 1955. Outputs of the principal minerals during that period were as follows: Pyrites 550,274 tonnes (484,023 tonnes in January-October, 1954); tin concentrates 1,318 tonnes (1,221); wolfram concentrates 3,047 tonnes (3,098); haematite 128,904 tonnes, magnetite 38,015 tonnes and manganese 3,339 tonnes. Outputs for the period January-September, 1955, included beryllium 241 tonnes, tantalite/columbite 22 tonnes, molybdenum 9 tonnes, and gold/silver bearing material 3,687 tonnes. The entire production of these minerals is exported.

PRINCIPAL MINERAL EXPORTS
(in tonnes)

	1954	1955
Pyrites	383,995	**451,355**
Tin conc.	746	**322**
Haematite	83,977	**121,170**
Magnetite	21,581	**47,296**
Manganese	3,500	**5,860**
Wolfram conc.	3,849	**4,476**

The corporation formed for the production of iron and steel from iron ores now being exported has not yet decided where to erect the furnaces. The Government is resolved to favour the interests of the nation rather than those of the individual in deciding on "where" and "how." The difficulty has been to combine an adequate supply of electrical power, transport facilities and manpower. There are only three large iron orebodies in the country, none of which are especially favoured in regard to transport or manpower. It remains to be seen whether the plan for the manufacture of tinplate will entail erecting the plant on the same site as that for producing iron and steel, and also what its effect will be on the production and export of cassiterite. In the first eleven months of last year Portugal imported 34,305 tonnes of tinplate and she uses about 22,000 tonnes of metal per annum. It is anticipated that when the projected plant is brought into production, local consumption will absorb domestic output.

The improvement in both production and exports, which took place in 1955, is in marked contrast with the plight of the mining industry during the previous year. It has, of course, come about largely as a result of the improved demand for metals and minerals, but is doubtless due in some measure to the Government's more realistic attitude towards the mining industry and its problems, as evidenced by the reduction of the export tax on tungsten ores, which came into effect towards the end of 1954.

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France

By R. Rabussier*

IN France the index of industrial production has risen by 10 per cent since 1953. If this pace is maintained, it will result in the doubling of the volume of industrial production in seven years' time.

Solid Fuels

The coal industry has a double record to its credit in 1955; production rose to the new peak of 57,400,000 tonnes, while productivity has been raised to 3,509 lb per manshift. Stocks of solid fuels, which had previously diminished in other countries of the High Authority of the European Coal and Steel Community since 1954, owing to increased demand, began to be re-absorbed in France from April, 1955, onwards. By September, 1955, unemployment in the coalfields caused by lack of sales had almost disappeared. This transformation in the position of fuel is due, in part, to a series of measures taken towards the end of 1954 (lowering of price of industrial coals, rise in price of fuel, limitation in sales of fuel) and in part to increased demand from the steel industry and shortage of coal supplies in Western Europe. French exports, which amounted to 3,000,000 tonnes in 1954, totalled 6,600,000 in 1955.

Steel Industry and Iron Mining

French production of crude steel reached the record figure of 12,500,000 tonnes in 1955, this being 18 per cent above the figure for 1954. This increase was made possible by the putting into commission of important new plants, and by the modernization of existing works. Thus, two blast furnaces, one at Homecourt (Sidelor) and one at Senelle (Lorraine-Escaut), were closed, while modernization of equipment was carried out in many other blast furnaces. There is a risk, however, that difficulties in the supply position of metallurgical coke may prevent the expansion of production to the fullest extent of which these new plants are capable.

The supply of iron ore occasioned no difficulty in 1955. Actually, production of pig iron was raised by 23 per cent and extraction of iron ore by only 15 per cent during the period, but this difficulty was overcome by taking over the necessary quantities from stocks at the iron mines, which had been inflated during the course of 1954.

French mines are able, not only to satisfy home demand in the steel industry, but to export ever-increasing quantities of iron ore.

Ferro-Alloys

The increase in the French production of ferro-alloys corresponds with the ever-growing needs of the domestic steel industry and the expansion of foreign markets. Production of both ferro-silicon and ferro-manganese rose by 50 per cent, and exports have practically doubled. Production of ferro-chrome was raised very appreciably, but the supply of ore was at times difficult.

Bauxite and Aluminium

French bauxite production was maintained at a monthly level of 140,000 tonnes (never before attained), so long as atmospheric conditions were favourable. Alumina production was able to continue without difficulties. It was raised to 350,000 tonnes in 1955, compared with 329,400 tonnes in 1954. The slight improvement in aluminium production came about partly because of the coming into use, in March, 1955, of the new pot lines in the Péchiney plants at Saint-Jean de Maurienne, and also as a result of the advances achieved in using the plants currently available. Nevertheless, the demand for aluminium was extremely high, and it was necessary to fall back on imports.

In order to satisfy the ever-increasing demand in the next few years, the resources of Metropolitan France and French Africa should receive further assistance in the form of capital investment, particular requirements being a plant at Edea in the Cameroons and the building of a "complex" at Guinea.

Magnesium and Titanium

French production of magnesium is not able to satisfy demand, and it does not appear likely that this suitation will change much in the next few years.

Titanium production is in the course of passing from the experimental to the industrial stage. All the quantities of titanium which are produced are mainly absorbed by the aeronautical industry.

METAL AND MINERAL OUTPUT
(in thousands of tonnes)

	1954	1955
Crude oil	505.2	**875.7**
Natural gas* ..	268,400	**266,300**
Coal and ligite	56,315	**57,388**
Iron ore	44,320	**50,320**
Pyrites	300	**305**
Bauxite	1,275	**1,492**
Aluminium	147	**160.7**
Zinc	136	**138.1**
Lead	82.4	**92.6**
Copper (electro)	13.1	**14.2**
Copper (blister)	9.6	**8.2**
Nickel	4.8	**5.5**

* Cubic metres.

Other Metals

French zinc ore production was 20,400 tonnes in 1955 compared with 18,200 in 1954. Demand for zinc was well maintained during 1955, but was easily satisfied by production from domestic smelters, and by using ores produced in the French Union, which were treated in other countries, the metal being then imported into France.

Domestic production of galena was 13,700 tonnes in 1955, compared with 16,600 in 1954. Supplies of lead ore were ample for domestic and North African smelters, which met all needs, and even had a surplus available for export to Great Britain, Germany, Italy and other countries.

Copper is no longer mined in Metropolitan France, nor is it treated there. Only at Le Palais (Haute Vienne) and at Vienne (Isère) are there still small smelting works, supplied with mattes, alloys and scrap imported or recovered.

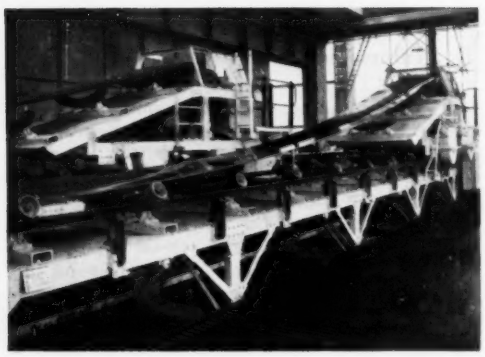
So far as pyrites and gold-bearing ores are concerned, the re-opening of the Salsigne mine will, to some extent, compensate for the shutting down of the Châtelet property.

Atomic Industries

France's deposits of uraniferous materials occur mainly in four localities: the Grury region (Saône-et-Loire), the Lachaux region (Puy-de-Dôme), the Bois-Noir region situated in the mountains of Forez, and finally in the Vendôme area where two occurrences are known, one at La Chapelle-Largeau near Montagne-sur-Sevre and one near Clisson.

The production of uraniferous minerals is sufficient for the requirements of France's Atomic Energy Commission. Although the tonnages at present extracted in France and the French Union are small in relation to world production, it is very probable that in a few years France and the French Union will rank collectively among the leading world producers. France's first nuclear reactor, G1 at Marcoule, was started up on January 7, 1956. It is also the first graphite reactor in western Continental Europe.

*Head of the Bureau of Mineral Documentation (Statistics)



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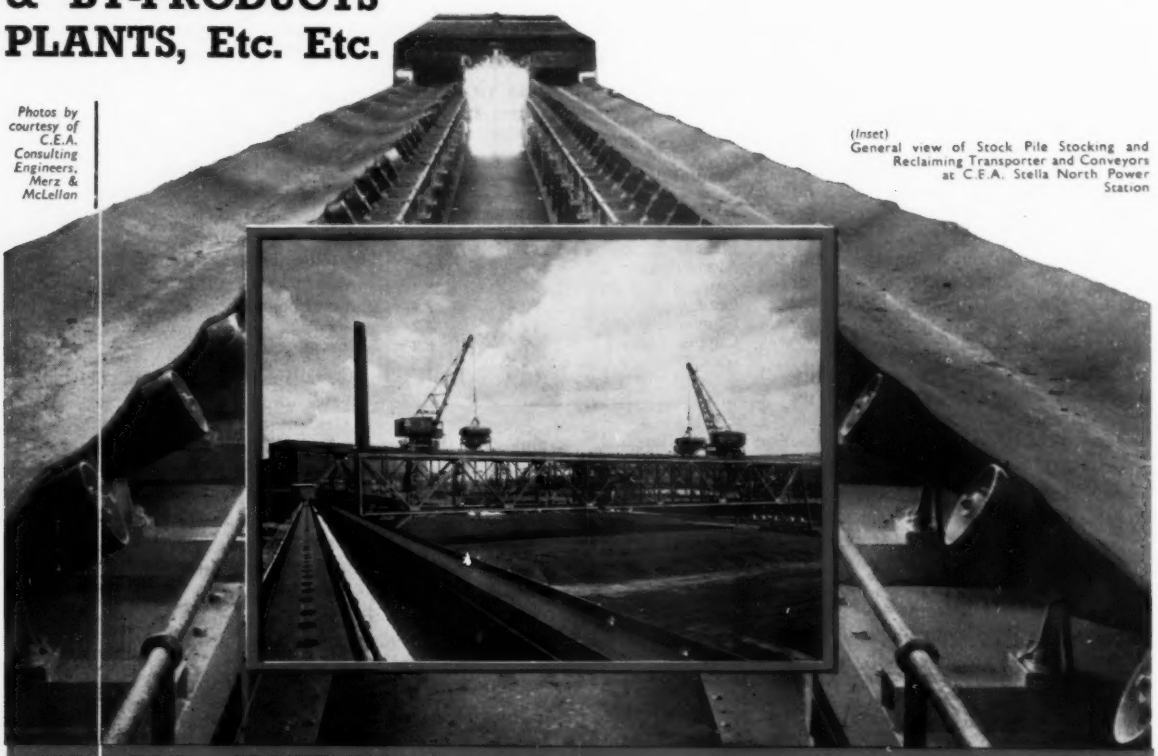
(Inset)
General view of Stock Pile Stocking and Reclaiming Transporter and Conveyors at C.E.A. Stella North Power Station



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Western Germany

GERMANY'S ground has been so thoroughly investigated for several centuries in the search for useful minerals, that all the easily accessible deposits are more or less exhausted. The reserves of fossilized fuels and potash salts in large and readily mined deposits are becoming ever smaller. Extraction of minerals, and also of some lignite, must be carried on at great depth, and in ever

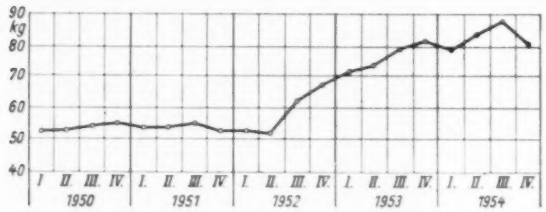

Fig. 3. Productivity per man-shift in kg.

thinner and more difficult seams. Deposits must be mined to exhaustion if difficulties and costs of extraction are not, with increasing depth, to render mining all too quickly uneconomic. That applies even more to metal mining, and particularly to non-ferrous metal mining. For the rich oxides and cement areas have been worked out for centuries, and many important metals are no longer available in exploitable quantities.

The location of the principal mining centres of Western Germany can be seen from the accompanying map of Germany in 1937 (Fig. 1).

In 1955 the Kurhessische Kupferschieferbergbau ceased production. This company, the last one to mine copper in Western Germany, produced in 1954, 130,086 tonnes of copper ore, 5,008 tonnes of copper concentrates, and 474 tonnes of copper matte. Its more valuable Mansfeld property lies in the Soviet zone. In 1955 the total mine production of copper in Western Germany was 1,200 tonnes. This figure also includes copper won from slag heaps and obtained as a by-product when treating other metals. In 1954 the total value of the copper output was DM.3,200,000, barely 3 per cent of the value of all metal production.

The balance, DM.107,706,000, was obtained from lead and zinc. In 1954 production amounted to 3,850,031 tonnes of crude and 332,181 tonnes of usable ore, containing, 67,287 tonnes of lead and 94,227 tonnes of zinc. In 1955 about 68,000 tonnes of lead and 120,000 tonnes of zinc were produced, the latter figure including the production from pyrites mining, as in previous years.

Lead and zinc production from 1949 to 1955 in comparison with 1935 are diagramatically shown (Fig. 2).

Compelled as they are at the present time to mine substances which are difficult to exploit and hard to treat, it is understandable that many Western German mines

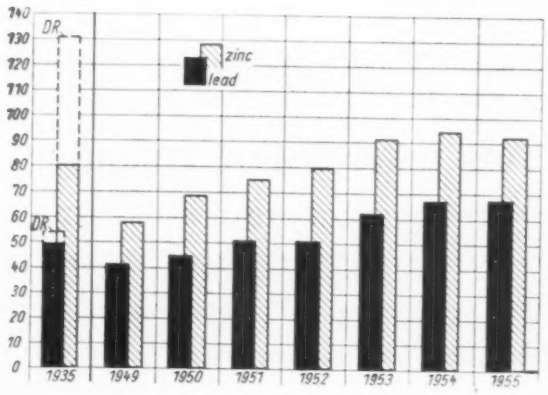

Fig. 2. Production of lead and zinc in Western Germany by thousands of tons (DR = Deutsches Reich)

work on the margin of economic payability. Thus, the old mine of Schauinsland at Freiburg in Breisgau had to close in 1955, while the Rosenberg mine in Rhenish Devon district was able to take up mining again as a result of new disclosures. Most of the remaining mines could only continue to operate by improving their organization, and in stable market conditions.

Progress in ore treatment is playing an important part in their survival. Refining techniques involving wet mechanical processes, which are selective, enable the smallest granules to be treated. For example, flotation has been successfully applied since 1953 to the treatment of the mineable resources of the old mine at Rammelsberg, near Goslar. These ores are schist layers banded with ore-impregnated stripes, and with only 8-10 per cent metal content and a complex composition, they had previously been difficult to smelt, either prepared or unprepared. The use of flotation methods has also enabled the lead ore mines in mottled sandstone of North Eifel to improve the preparation and smelting procedures.

As can be seen from Fig. 3, the quantities of lead and zinc produced per man and shift have risen fairly steadily since 1952. This progress would hardly have been possible but for the fact that world market conditions for non-ferrous metals as a whole have steadily improved, particularly in 1955. For there is no tariff protection for these metals, and subsidies would cut across free market economy which is Western Germany's basic policy.

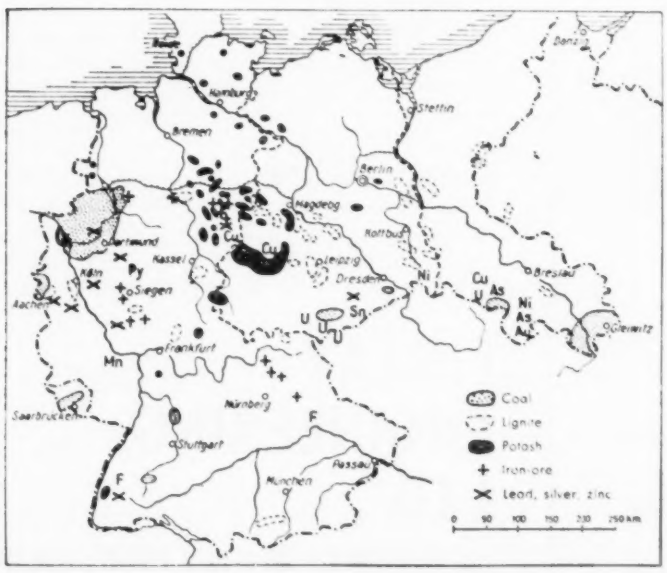

Fig. 1. Germany in 1937, showing the locations of the principal centres of the mining industry

An Indian Gold Mine

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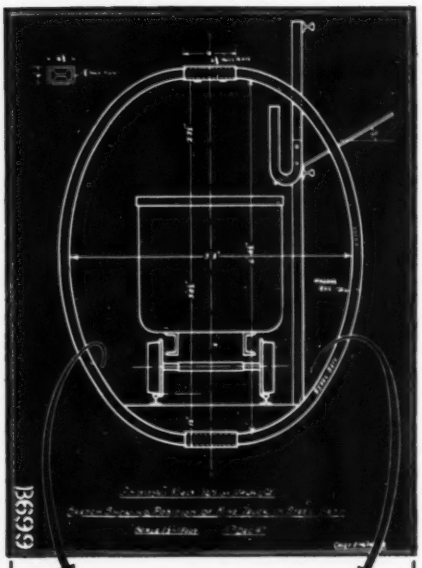

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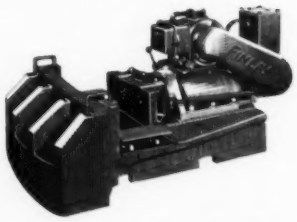

A 70-ton Finlay Model as used in the Indian gold mine.

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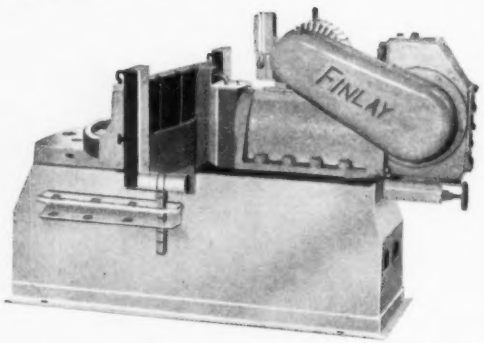

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Sweden

HIGHER exports coupled with an increased demand from domestic steel works were reflected by a record production of iron ore during 1955, and all signs point to a still greater production in 1956.

At LKAB, Kiruna, the first section of the new central shaft and dressing plant is now in operation. At Malmberget the new hoisting plant with belt conveyors is in operation. The pelletizing plant, with a capacity of 100,000 tons of pellets, is now in commission and comes up to expectations. Extensions to LKAB's stocking grounds at Narvik, Norway, have been completed. A new iron sponge plant of 30,000 tons capacity at Oxelösund, owned by the Grängesburg Company (TGO), has been put into operation. TGO has decided to begin mining the Strassa iron ore fields in Central Sweden for the production of 450,000 tons of magnetic concentrate, having 70 per cent Fe and 0.007 per cent P, as well as a small quantity of haematite concentrate having a lower percentage of iron.

CHIEF MINERAL PRODUCTS
(in tonnes)

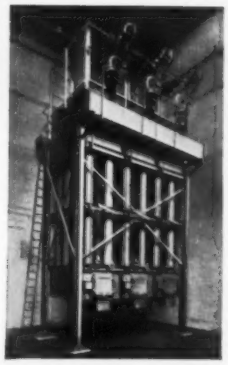
	1954	**1955**
Iron ore	15,716,000	**17,450,000**
Iron pyrites	398,235	**391,561**
Lead concentrate ..	40,372	**43,870**
Zinc concentrate ...	103,735	**104,557**
Copper concentrate	53,776	**67,163**
Tungsten carbide (60% WO_3)	450	**458**

In Central Sweden, Häksberg will raise production to an annual level of 240,000 tons of concentrate. Gravity concentration of haematite will be replaced by the flotation process. The magnetic dressing plant at Dannemora has been put into operation and is expected to yield 255,000 tons of manganiferous iron ore. A new shaft tower has been erected at the Bergslags shaft in Grängesberg. It is estimated that the quantity of rock hoisted from the 410 m. deep shaft will amount to 300,000 tons of rock per annum, which is expected to yield 200,000 tons of iron ore concentrate. A shaft tower with multi-cable hoist has been erected at the Tuna Hästbergs 510 m. deep central shaft for hoisting 150,000 tons of ferruginous ore per annum. At Vingesbacke the new shaft has been sunk to 423 m. and rock estimated to yield 100,000 tons of iron will be hoisted from a shaft with a headgear 46 m. high, housing two fully automatic hoists.

At Forsbo it is planned to extend the dressing and crushing plant for an annual production of 50,000 tons of magnetic iron ore. The mine plant at the Moss mine, which was destroyed by fire, is to be re-erected. Work is in progress at Norberg for the provision of a central plant by the Norbergs Grufförvaltning (Mining Administration) by driving a 1,460 m. long haulage drift on the 250 m. level

The Boliden Mining Company are preparing to begin mining 150,000 tons of lead ore per annum in the Idre field in the north of Sweden. In the Skellefte field the driving of a 5,000 m. long haulage drift from the Langsele mine to the concentration plant has been completed by the Boliden company.

At the Högänas mines in the Province of Scania, 280,360 tons of coal and 167,480 tons of refractory clay were extracted during the year.



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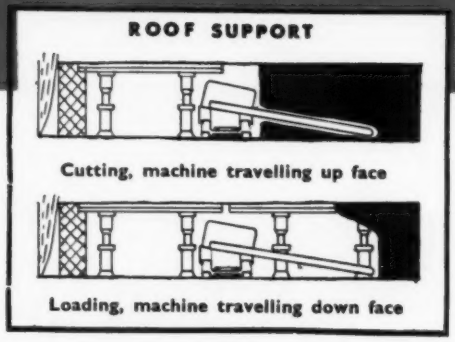

The efficient extraction of coal from the thinner seams is of ever increasing importance to the coal industry and much work has been done already by mining engineers on this vital problem.

Experience has proved the importance of taking the biggest possible web of coal that geological conditions will allow so as to make the yield economically attractive from a given length of face, therefore, orthodox timbering is indicated.

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Colonial Geological Surveys

THE Geological Survey Departments in a number of territories at last reached full strength during 1955 and good progress was made in geological mapping, in the exploration of mineral resources, and in the investigation of geological problems connected with engineering and water supply schemes. There were 205 geologists, geophysicists and chemists in the 21 oversea territories where geological survey operations were proceeding, in addition to a useful number of departmental prospectors, field officers, records officers and technical assistants. Twenty vacancies for oversea geologists still remained at the end of the year.

Less mapping than had been hoped for was possible in Kenya, Tanganyika, Nigeria, the Gold Coast and Fiji, either because of other urgent duties or shortages of staff. During the year the Director of Colonial Geological Surveys visited East Central and South Africa, the Caribbean region, the United States, Canada, and French West Africa, and other members of the Directorate visited Somaliland, East Africa, Bechuanaland and Nigeria.

The Search for Minerals

Mineral investigations continued in a number of territories with promising results. An important company is examining the carbonatite complex at Mrima in Kenya with its ores of niobium and the rare earths; the exploration and development of the pyrochlore-bearing carbonatite at Panda Hill near Mbeya in Tanganyika is now in commercial hands; a company proceeded with its investigation of the pyrochlore deposits in the carbonatite at Nkumbwa Hill in Northern Rhodesia; and another holding an Exclusive Prospecting Licence over the Kangankunde monazite in Nyasaland has been active.

An oil-prospecting company is collecting much geological information in Tanganyika and is putting down a well in Mafia Island to a considerable depth. Small quantities of columbite, beryl and mica have been exported from Somaliland during the year. In Bechuanaland, the investigation of coal areas continues and some boreholes have been drilled. Diamond drilling near Darkton, in Swaziland, has shown an increase in the probable reserves of haematite containing over 60 per cent Fe from 20,000,000 to 50,000,000 tons. Coal drilling will soon take place in another Swaziland area.

The drilling in Nigeria to determine coal reserves in Onitsha, Benue and Kabba Provinces has been completed and reserves are indicated of 244,000,000 tons of workable coal, of a quality similar to that being mined at Enugu. The investigation continued of the distribution of primary columbite in the Younger Granites of the Jos Plateau. The drilling of pyrochlore-bearing granite in the Kaffo Valley was completed. The Shell D'Arcy Petroleum Development Company of Nigeria Limited has continued its investigations, including seismic surveys and drilling tests; a further discovery of oil was made in the test well at Ituk, but no commercial production could be established.

An oil company is said to be contemplating exploratory drilling in the Gold Coast as a result of information given by the Geological Survey Department. Mineral exploration by the Geological Survey continues in Sierra Leone and activities are soon to be reinforced by the help of the Geochemical Prospecting Research Centre.

Oil has been discovered in the Jerudong structure near the Seria field and is considered to be the most promising post-war find in Brunei. Useful deposits of stone and gravel have been found in west Sarawak and Brunei as the result of co-operation between the Geological Survey and the Public Works Department. The discoveries are of some importance in a territory where road-metal is very difficult to find.

In Cyprus there has been a gradual increase in mineral production. Geophysical prospecting by a mining company followed by drilling has led to the discovery of a cupreous pyrite orebody of about 3,000,000 tons.

In British Guiana the Geological Survey Department has been prospecting shallow alluvium of tributaries of the Cuyuni River by means of banka drills to determine the gold content. No deposits of economic value have yet been found but the most promising area has still to be reached.

In Fiji, output of manganese ore has slightly increased. Gold lodes have been discovered by the Geological Survey Department of the British Solomon Islands Protectorate at Gold Ridge in Guadalcanal; promising results were obtained by the Department's exploratory work and a mining company which has taken an option over the lease will now make a thorough investigation.

More Funds Available

A further allocation of £1,250,000 has been made available for Colonial Geological Surveys under the Colonial Development and Welfare Act, 1955, to cover the period up to March 31, 1960. In addition to providing for the work of the Directorate at Headquarters, the funds available will enable some assistance to be given to those territories which are themselves unable to meet the cost of their Geological Survey Departments. The geological investigations which are now actively proceeding on the necessary scale in 21 Colonial territories have been made possible through the considerable help given in the past by Colonial Development and Welfare Funds for increasing staffs and improving accommodation and equipment.

Collaboration from Universities

The Geochemical Prospecting Research Centre recently set up at the Imperial College of Science and Technology in London with the assistance of a C.D. and W. grant has continued to give valuable help to Colonial territories. Geologists from this organization have again visited Uganda, and several other territories are sending geologists to the Centre for training.

The Geology Department of the University of Durham is continuing its study of the chromite deposits of Sierra Leone, and further visits are being made to the territory at the instance of the mining company concerned. A geophysicist from Durham is making gravimetric observations with a view to the siting of diamond-drill holes in the Colony Peninsula to explore the structure and petrology of the base of the layered gabbroid complex where nickel ores may occur.

Members of the teaching staffs at the Universities of Oxford and Bristol spent three or four months in Kenya making geological and topographical maps of Miocene rocks on islands in the Kavirondo Gulf of Lake Victoria and collecting mammalian fossil remains. A lecturer from the Department of Geology at Edinburgh spent two months in Kenya investigating tectonic problems in an area of marbles and allied rocks where there are occurrences of kyanite, garnet, graphite and talc.

A geologist belonging to the Oxford University Exploration Club Expedition spent six months in Sarawak in the Upper Rajang and the Usunapau Plateau, and later he spent some months at the Geological Survey Headquarters in Kuching.

The British Isles

By J. B. RICHARDSON, A.R.S.M., M.I.M.M.

INDUSTRIES in the British Isles which are consumers of virgin non-ferrous metals and their ores are almost entirely dependent on importation for their requirements of these materials. Some of the world's leading mining organizations consider that this precarious situation might be alleviated to a useful extent by exploitation of potential sources of base metals within the country.

Growing interest in the possible revival of Britain's once flourishing metal mining industry is reflected in the recent formation of the United Kingdom Metal-Mining Association, whose members include such powerful concerns as New Consolidated Goldfields, Selection Trust, Rio Tinto, the British Metal Corporation, and Johannesburg Consolidated Investment Co. Ltd. Its objects are to promote and encourage the interests of those engaged in, or wishing to engage in, the mining of metals and minerals other than coal in Britain and the Isle of Man.

England, Scotland and Wales

Despite the difficulties under which the metal mining industry is labouring, prospecting and mining operations are being undertaken by a number of concerns in various parts of Britain.

In Derbyshire Rio Tinto have taken over the interests of J.C.I. in the Matlock Lead Mines. Further north, in the Weardale-Teesdale area, Paringa Mining and Exploration Co. started to treat the large accumulation of fluorspar-rich dumps of that district but have recently suspended operations. This same firm investigated the possibility of re-opening one of the old London Lead Company's mines, Sharnberry. It is rumoured that Zinc Corporation are showing some interest in possible lead producing properties in the same area.

Meantime Anglo-Austral, Weardale Lead, Granhope Burn, Blanchland, Laporte at Silverband, as well as Close House, Coldberry and Greenside keep metal-mining alive in the northern counties and continue producing fluorspar, barytes, lead and zinc concentrates. Weardale Lead have had a troublesome year with much development and delays in effective milling. Coldberry are getting their lead ore from the Great Limestone, the first time this sill has been worked for lead in this district. At Swinhope New Consolidated Goldfields are carrying out a diamond drilling campaign.

In Scotland the Lowland Lead Company at Leadhills is erecting a new gravity-flotation mill to treat both tailings and mine ore for the production of lead and zinc concentrates. Some delay has ben experienced in obtaining the requisite structural steel for housing the mill machinery but production is expected to start in the autumn. Meantime over 600 ft. of development has exposed galena of payable grade.

In Wales, Halkyn District United Mines reported in June last that substantial additions to their reserves had been made over the previous 12 months and half the lead content of the mill feed came from development. The sea level tunnel advanced southward over 600 ft. It is not known whether a decisive step has been taken to move the concentration plant further south to avoid that section of the tunnel subject to flooding. The Parc Mines of the Llanrwst Lead Mines, a subsidiary of J.C.I., continues to produce high-grade lead and zinc concentrates, but the grade of ore has declined and it has been decided to carry out a drilling campaign at greater depth. At the north-west corner of Anglesey near Amlwch, the British Metal Corporation and local landowners have come to terms for re-opening the old Parys Copper Mines, and it is reported that preliminary investigations have started. The attempt to retreat gold-bearing tailings and re-open a gold mine near Dolgelly has been abandoned.

The Isle of Man

On the Isle of Man, the Island Exploration Company, on the board of which besides local businessmen, British Metal Corporation and John Taylor are represented, has obtained a four year prospecting licence. Active prospecting by a large team using the most modern methods is being carried out and J. M. Bruckshaw is consulting geophysicist. On the same island Metalliferous Holdings has re-opened the small lead mine on Snaefell and plant has been erected to treat old dump material. It is said that a Canadian concern is seeking an interest on the Island.

Eire

The desirability of providing conditions favourable to mining expansion has been recognized by the Government of Eire, whose approach to the development of non-ferrous metal resources is much more realistic than that of the U.K. A Bill introduced in 1955, which recently passed the committee stage, exempts a Canadian firm, the Mogul Mining Corporation of Toronto, from paying any taxation for four years and further relief is granted by halving taxation during the next four years. The Canadian company is to exploit the famous old Avoca group of mines, active from 1790 to the end of the nineteenth century. A new company formed for this purpose, St. Patrick's Copper Mines Ltd., will eventually mine at a rate of 1,000,000 tons a year. A first charge on profits is a 4 per cent royalty on operating profits up to £35,000, rising to 9 per cent on profits over £175,000. The government of Eire also reserves the right to purchase 50 per cent of the metallic products. A lease for 21 years from October 1, 1955, was executed on January 3, 1956, and transfers the rights to mine copper, lead, zinc and pyrites and other minerals over an area of 6,900 acres.

The Mining Corporation of Ireland, a subsidiary of Can Erin Mines Ltd., of Toronto, Canada, has received Government approval of its plans to develop an area of 50 sq. miles at Castleblaney, County Monaghan, and an area of 10 sq. miles at Beauparc. The company will work copper and zinc mines which have been closed for 50 years but are reported to have large deposits of good quality ores. Test borings were expected to begin at Beauparc, County Meath, on May 1, 1956, and may last up to three years.

At Glendalough, in County Wicklow, a mining company is about to add flotation units to its present mill to increase the output of lead and zinc concentrates. Development has proved that the veins being mined continue to 100 ft. below adit level.

Silvermines Lead and Zinc Company in Tipperary continues in production and is said to be planning an extensive development programme. It has already deepened the main shaft and excavated pump chambers and ore bins and an HMS plant should be in operation in a few month's time. At Abbeytown Mining Company in County Sligo development started over a year ago has shown an appreciable improvement in grade of ore and the company, another subsidiary of J.C.I., is making satisfactory profits.

Cornwall and Devon

by Our Own Correspondent

THE major development in the West of England has been the decision to expand production at South Crofty Mine and to re-model the whole of the concentrating plant. The electric pumping installation was completed during the year and the old Cornish pumping engine at Robinson's shaft was finally stopped in May.

Early in the year, plans were drawn up for modernizing and enlarging the treatment plant involving the installation of secondary crushing, provision for pre-concentration by means of H.M.S., and the complete redesign of the gravity section of the plant including provision for increased middling grinding. The whole of the work will be done without interfering with production and erection work has commenced, whilst a considerable part of the new plant is now on order or on site. When completed, the plant will be able to handle at least 8,000 tons per month. In order to finance the capital expenditure involved, the company has reached arrangements with Messrs. Williams, Harvey and Co., the tin smelters of Liverpool, and Tehidy Minerals Ltd., to provide a loan up to £100,000.

Output was again increased in 1955 and the amount of tin produced was the best for the past 10 years but heavy costs incurred for pumping before the new installation was completed prevented profitable operation.

The other major tin producer in Cornwall, Geevor mine, continued to operate very satisfactorily throughout the year and some modifications have been made in the retreatment plant as well as two Humphreys spirals added as scavanger units. It is understood that further spirals are to be installed. In the 12 months to March 31, 1955, 57,399 tons of ore were mined averaging 25.87 lb. of black tin per ton and 634.69 tons of concentrate (65 per cent Sn) were recovered.

During the year, the Victory shaft was sunk 64½ ft. to a total depth of 116 ft. below the 15th level. Work on the crosscut in the Underseas sett on the 11th level has been stopped, but it is proposed to drill two diamond drill holes from this crosscut to intersect the extension of lodes previously developed in Levant mine.

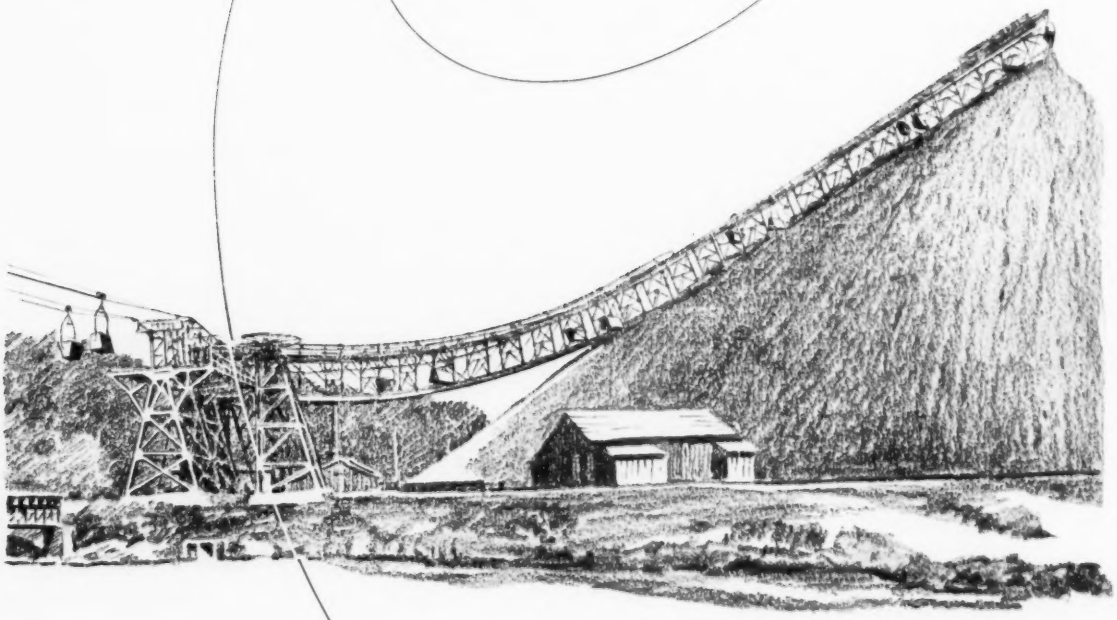
Two of the smaller operators in Cornwall suspended operations; namely, Mineral Recovery Ltd., who had been treating beach sand at Gwithian, and the Hawkswood Mining Co., who were operating a wolfram mine on the eastern fringe of Bodmin moor.

Elsewhere in Cornwall, a company has been sampling an accumulation of tailing in the Carnon valley, near Truro, where a considerable amount of material has been deposited during the tin and copper workings of the last century and contains some tin.

Little change in the mining situation in Devon has taken place both china clay and ball clay production remaining at a satisfactory level. It is reported that negotiations have been taking place for the disposal of the Memerdon wolfram mine and plant which belongs to the Government.

The china clay industry has been very busy during the year and the report of English Clays, Lovering, Pochin and Co. Ltd. shows an appreciable increase in tonnage produced, particularly as regards exports. The selling price of clay was maintained at the same level throughout the year but same increase has had to be made as from January 2, 1956.

On your mind...



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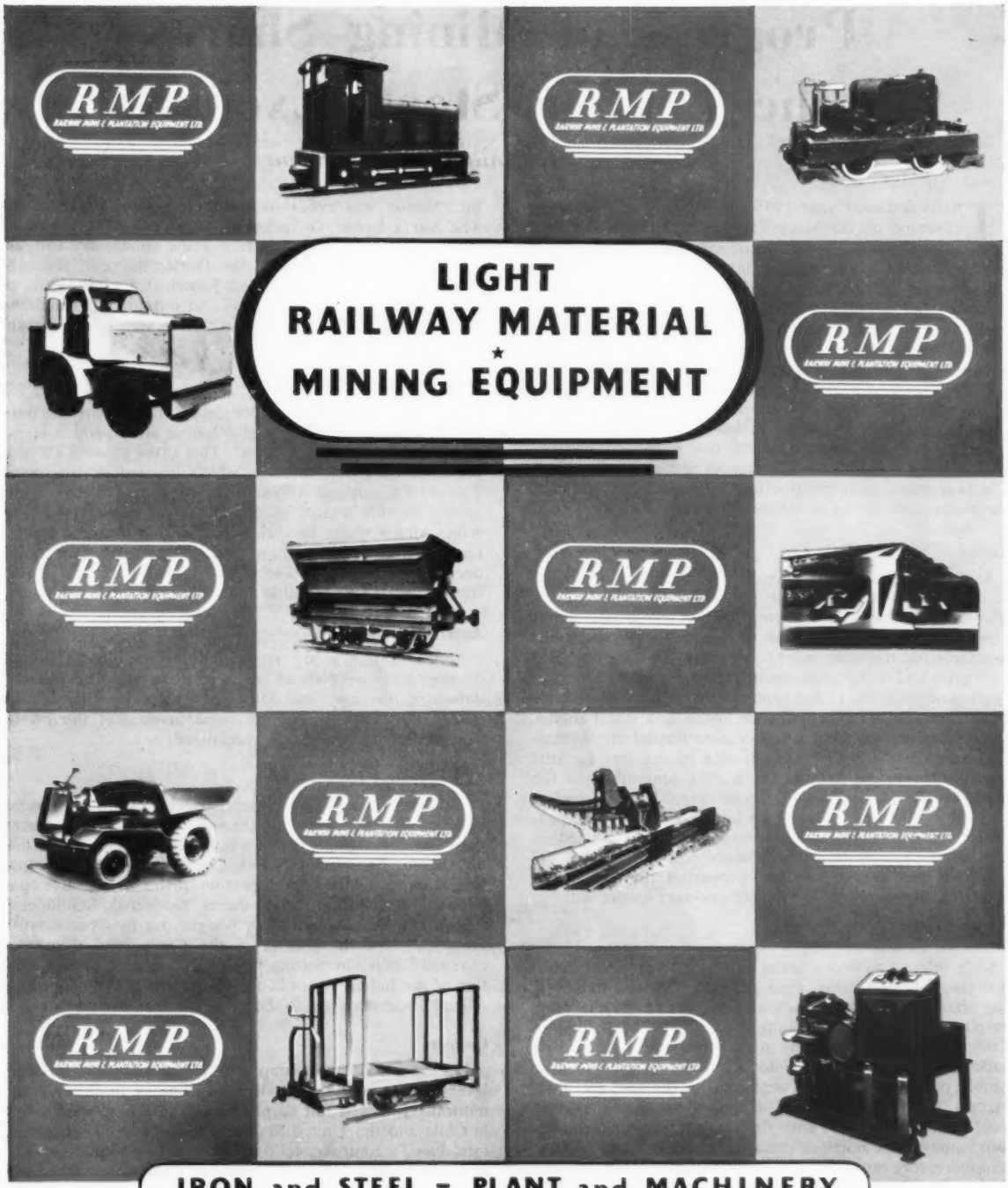

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Progress of Mining Shares on the London Stock Exchange

By Our Stock Exchange Correspondent

THE financial year 1955/56 was one of fluctuating fortune on the Stock Exchange. The election of a Conservative Government ushered in a wave of optimism and a sharp improvement in market prices. This came to an end in August and was followed by a considerable fall in values. The dominating factor was the position of the gold and dollar reserves and sterling overseas. The country's balance of payments worsened and deflationary measures were taken to stop the rot. The bank rate was raised to 5½ per cent and other remedies, including a sharp credit squeeze, were invoked. These, and the Chancellor's firm statement at Istanbul, checked foreign speculating against sterling, and the Bank of England entered continental markets in support of the transferable £. The year ended with the position distinctly better but with the reserves still in an unsatisfactory state.

Kaffirs

Kaffirs had a very poor year. At the beginning of the period, there had been some grounds for optimism, but prices steadily declined in narrow markets and general public support was conspicuous by its absence. Although the prospects for the older mines were tied up with the fixed gold price and rising costs, there was no doubt that political developments in the Union kept the ordinary small investor away from even the best finance house and Rand shares. During the year the Union Corporation floated the Winkelhaak mine in the Bethel Kinross area of the very far east Rand. One bright feature for Kaffirs generally was the improvement in the native labour supply which had a noticeable effect in cutting working costs at some properties. Uranium production was vigorously proceeded with although, from the shareholders' point of view, it became noticeable that at many properties this entailed a reduction in the grade of the gold ore sent to the mill.

Orange Free State Shares

Such interest as was evinced in Kaffirs was mainly concentrated on the Orange Free State. It did not, however, stop share prices from heavy declines during the the year. Despite this most of the leading mines did well and maiden dividends were declared by those companies which had made the most progress. Water fissures continued to give trouble but it was felt that engineers on the spot had now learned the best methods of dealing with them. It was decided not to go ahead with the Jeanette project owing to poor values in the north of the area. Freddies Consolidated gave increasing cause for anxiety with steady losses and the employment of cash reserves to keep the mine going. The fate of Loraine also remained in the balance. The Consolidated Goldfields floated a new property called Saaiplaas which, it was reckoned, would take about six years to reach the production stage.

Diamonds

Record sales of gem and industrial stones occurred in 1955. The companies in this group continued to declare high dividends. The first quarter of 1956 disclosed some falling off in sales but this had little effect on the market generally. During the period reports of a Russian diamond discovery in Siberia reached the market, but little reliable information was available and there was no major effect. The Sierra Leone Government withdrew a large part of Consolidated African Selection Trust concession and the company received compensation. During the year, platinum prices continued very firm and Rustenberg gave details of a scheme to expand production and output. This had the effect of keeping share prices in this section of the market firm throughout the period.

West Africans

Mining developments proceeded along anticipated lines until November when a native labour strike, which lasted until March, 1956, took place. This strike affected all properties in the group, many of which incurred serious losses. The old Taquah and Abosso mine was forced to close down finally for this reason. A committee of inquiry on native wages and working conditions sat during the year but its findings were not announced during the period. Due to this uncertainty and the financial setback caused by the strike, share prices remained little changed at very low levels.

Australians

Mines in this group attracted little attention, although developments went ahead much as expected. The consolidation of the new Gold Mines of Kalgoorlie interest proceeded satisfactorily, but otherwise investment interest in this market was quiet and specialized.

Miscellaneous Gold

This section was also rather neglected, although several items of interest occurred. Cam and Motor went ahead with their development plans and a rights issue was made to finance them. St. John d'El Rey at one time reached a low level, due to political developments in Brazil, but later confidence returned and the shares recovered. Goldfields Rhodesian Development was bought out by Consolidated Goldfields and the control of the Camp Bird Company changed hands. Increasing talk of the possible nationalization of the Indian mines in the Kolar group was capped by official discussions which started as the year came to an end.

Copper

During 1955/56 the copper price reached a record high level, due to world wide demand. Shares in this section naturally followed suit despite plans to increase production in Chile and the United States. The Selection Trust group introduced a controversial fixed price policy during the year and interesting developments by Messina, Rhodesia Katanga and Bancroft engaged public attention. Rio Tinto emerged as one of the dominating uranium interests in the world and the old Mount Lyell mine in Tasmania was able to go ahead with plans to develop its large low grade ore deposits. The year closed with an easier tendency in the metal price.

Lead/Zinc

Shares in this group remained strong during the year, aided by sustained demand for the metals. High profits were recorded by most Barriers and by mines operating in America. Lake George, which had been under a cloud due to labour difficulties, began to recover and more public

interest in the shares was evinced as the year went by. Plans to develop uranium projects in the Mount Isa district of Queensland went ahead rapidly.

Tin

Here again the strong metal price kept shares in this group on an even keel. The Paley Report on the long-term outlook for the metal acted as a stabilizing influence. The promise of independence to Malaya and Singapore did, however, bring about a cautious attitude in respect of companies operating in the Far East. Nigerians were affected by the ending of the American stockpiling of columbite at the premium price of £2,000 a ton. Following this, the mineral fell back to a nominal £850 a ton and companies which were major producers suffered considerable falls in income and share prices. Beralt Tin and Wolfram were a good feature throughout the year with record sales and dividends. From time to time, rumours of a change of control or domicile were heard.

Canadians

Canadian mines had a very good year as part of the dynamic expansion of Canada. The International Nickel Company were outstanding with record metal sales and a high dividend. The peak production by U.K. steel companies caused big advances in Canadian iron ore producers.

Miscellaneous

There was little major interest in this group, although towards the end of the year manganese shares achieved some prominence. South African and Rhodesian coal companies continued to expand satisfactorily and higher coal prices were a factor in keeping share levels reasonably consistent.

Prospects

Although the British mining industry at home and abroad expected sympathetic treatment of the industry's difficulties in the U.K. budget presented on April 17, this was not forthcoming. The budget aimed at consolidating previously introduced deflationary measures and affecting considerable new savings. How far the Chancellor's proposals will be effective in halting inflation remains a crucial question.

The South African budget introduced by Mr. Louw was more cheering for the long-term than for the actual concessions granted this year. That is to say, the South African Minister has taken a step—albeit a short one—in the right direction and the general belief is that concessions to the South African gold mining industry will be progressively more favourable with each coming year. The chief concessions granted this year were a small reduction in the taxation formula for gold mines, the assumption by the Union government of the £11,000,000 phthisis liability, and the tax concessions enabling mines to write off certain items of equipment up to £20,000 during the year of acquisition. Eagerly waited, however, is a clarification of how the government's concession will work out in practice of allowing ultra-deep mines to write off, before incurring taxation, 5 per cent annually of the share capital until production stage reached. Given a broad enough definition of what constitutes an "ultra-deep" mine this proposal could be important.

HIGH AND LOW PRICES REACHED BY LEADING MINING SHARES— JANUARY 1, 1955 to APRIL 6, 1956

Finance	High	Low
African & European	3¼	2 11/16
Anglo American Corpn.	9 3/16	7⅛
Anglo-French	26/10½	19/9
Anglo-Transvaal Consol.	1½	1¼
Central Mining (£1 shrs.)	49/9	38/-
Consolidated G'fields	65/9	53/6
Consol. Mines Selection	2 11/16	1 13/16
East Rand Consols	3/1½	1/6
General Mining	5 1/16	4
H.E. Prop.	10/10½	6/10½
Johnnies	46/6	35/6
Rand Mines	3⅜	3¼
Rand Selection	2½	1 15/16
Union Corporation	56/3	31/3
Vereeniging Estates	4¼	4
Writs	2 1/32	1 11/16
West Wits	43/-	36/3
Rand Gold		
Blyvoors	32/1½	22/10½
Brakpan	8/3	5/6
Buffelsfontein	41/4½	21/7½
City Deep	15/-	9/6
Consol. Main Reef	1 1/16	15/16
Crown	2 1/16	2 1/32
Daggas	3 1/32	2 1/32
Dominion Reefs	39/-	19/3
Doornfontein	34/10½	20/10½
Durban Deep	1⅜	1⅜
E. Champs	10/9	3/9
E. Daggas	12/-	8/6
E. Geduld (4s. units)	34/3	26/6
E. Rand Props.	3 1/16	2⅜
Geduld	4 9/16	3 1/16
Govt. Areas	11/6	4/9
Grootvlei	25/1½	18/6
Hartebeestfontein	42/4½	29/3
Libanon	9/3	6/10½
Luipards Vlei	25/9	15/3
Marievale	23/9	19/1½
New Kleinfontein	11/10½	4/9
New Pioneer	17/7½	11/4½
Randfontein	70/3	43/-
Robinson Deep	23/6	13/4½
Rose Deep	11/6	9/6
Simmer & Jack	4/10½	3/4½
S.A. Lands	1½	15/16
Springs	4/-	2/-
Stilfontein	28/9	23/-
Sub Nigel	2 3/16	1 7/16
Vaal Reefs	37/6	25/4½
Van Dyk	5/9	3/-
Venterspost	15/7½	11/-
Vlakfontein	19/1½	15/7½
Vogelstruisbult	36/9	19/6
West Driefontein	6	5 1/16

Rand Gold contd.	High	Low
W. Rand Consolidated	2 3/16	1 13/16
Western Reefs	48/3	30/7½
O.F.S. Gold		
Freddies	9/6	3/3
Freddies Consolidated	17/3	3/6
F.S. Geduld	6 5/16	3 3/16
Geoffries	19/9	12/1½
Harmony	39/4½	25/-
Loraine	14/9	5/3
Lydenburg Estates	27/1½	14/3
Merriespruit	14/-	8/4½
Middle Wits	21/9	11/3
Ofsits	78/9	53/9
President Brand	75/3	55/7½
President Steyn	52/9	29/4½
St. Helena	32/-	24/-
Virginia Ord.	17/6	9/7½
Welkom	31/3	16/-
Western Holdings	5 1/16	3 1/32
West African Gold		
Amalgamated Banket	2/7½	1/8½
Ariston	7/6	4/10½
Ashanti	25/3	18/-
Bibiani	5/4½	3/-
Bremang	1/7½	1/3
G.C. Main Reef	4/-	1/10½
Konongo	3/4½	1/9
Taquah	3/4½	1/3
Western Selection	11/4½	7/6
Australian Gold		
Gold Mines of Kalgoorlie	15/6	11/3
Great Boulder Prop.	11/9	8/4½
Lake View & Star	20/7½	14/9
Mount Morgan	25/6	18/7½
North Kalgurli	8 9/16	6/-
Sons of Gwalia	8/-	2/9
Western Mining	11/3	8/9
Miscellaneous Gold		
Cam & Motor	9/6	7/9
Champion Reef	6/-	3/9
Falcon Mines	7/9	6/3
Globe & Phoenix	27/-	23/-
Motapa	1/7½	1/-
Nundydroog	8/-	5/9
Ooregum	4/7½	2/3
St. John d'El Rey	20/6	11/3
Zams	63/-	44/6

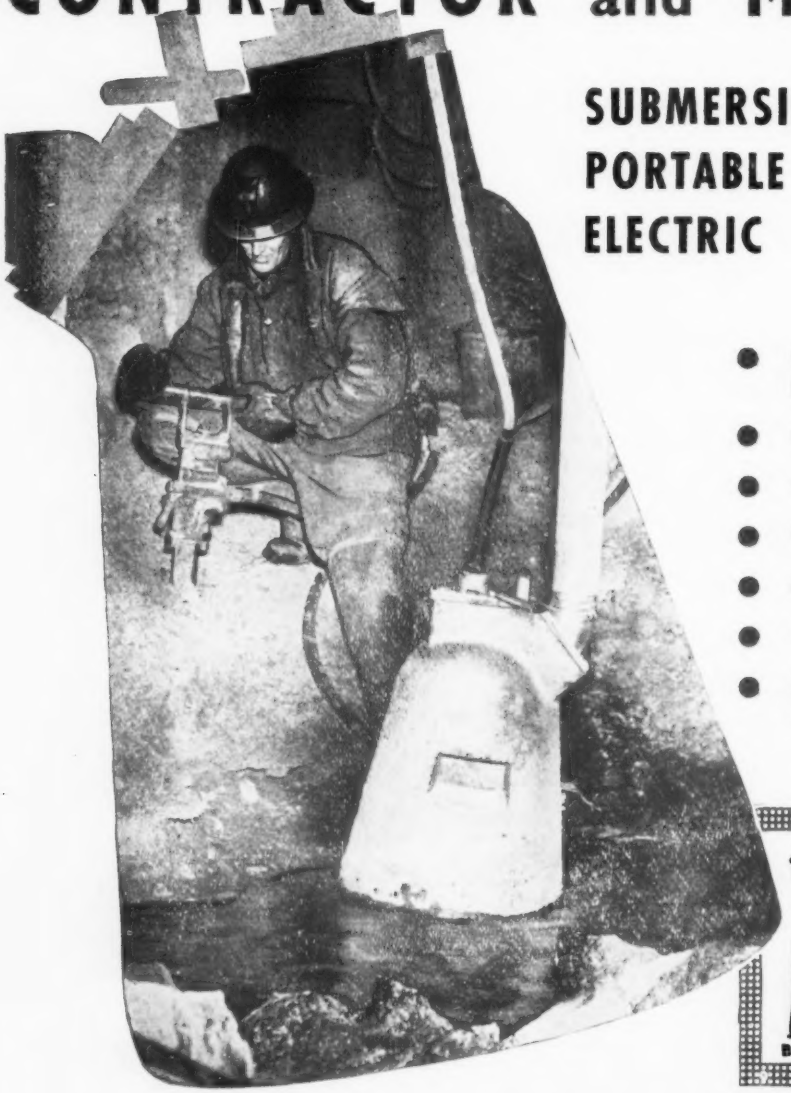
Diamonds and Platinum	High	Low
Anglo American Inv.	10	7½
Casts	31/6	23/4½
Cons. Diam. of S.W.A.	8½	6 13/16
De Beers Defd. Regd.	6 11/16	5 1/16
De Beers Pfd. Regd.	17½	14½
Pots Platinum	12/6	11/-
Waterval	20/-	18/1½
Copper		
Bancroft	47/3	34/6
Chartered	77/-	51/10½
Esperanza	6/1½	2/9
Messina	10 1/16	6 11/16
Nchanga	17⅜	11 13/16
Rhod. Anglo-American	6 11/16	4 7/16
Rhod. Katanga	36/6	16/3
Rhodesian Selection	58/3	29/6
Rhokana	50	31½
Rio Tinto	4½	2 15/16
Roan Antelope	31/3	22/9
Selection Trust	93/6	63/4½
Tanks	10	6½
Tharsis Sulphur Br.	8¼	4
Tin (Eastern)		
Ayer Hitam	35/-	20/9
Gopeng	11/4½	7/1½
Hongkong	8/10½	6/10½
Ipoh	24/6	19/-
Kamunting	11/9	6/9
Kepong Dredging	3/9	2/7½
Kinta Tin Mines	19/4½	10/4½
Malayan Dredging	11/3	8/1½
Pahang	14/10½	10/9
Pengkalen	13/4½	8/4½
Petaling	12/4½	7/10½
Rambutan	25/6	16/-
Siamese Tin	9/7½	5/1½
Southern Kinta	21/1½	15/4½
S. Malayan	9/3	7/-
S. Tronoh	11/10½	7/1½
Sungei Kinta	18/-	11/-
Tekka Taiping	9/10½	6/-
Tronoh	10/6	7/3
Tin (Nigerian and Miscellaneous)		
Amalgamated Tin	14/10½	11/-
Beralt Tin	44/4½	25/10½
Bisichi	8/4½	5/1½
British Tin Inv.	27/6	18/6
Ex-Lands Nigeria	3/1½	2/3
Geevor Tin	17/7½	12/4½

Tin (Nigerian and Miscellaneous) contd.	High	Low
Gold & Base Metal	2/10½	1/6
Jantar Nigeria	8/9	5/1½
Jos Tin Area	15/3	12/6
Kaduna Prospectors	3/3	1/6
Kaduna Syndicate	3/1½	2/4½
London Tin	10/1½	6/9
United Tin	3/1½	1/6
Silver, Lead, Zinc		
Broken Hill South	61/-	50/-
Burma Mines	6/-	2/3
Consol. Zinc	59/-	40/6
Lake George	16/7½	7/3
Mount Isa	21/4½	11/9
New Broken Hill	48/3	33/3
North Broken Hill	96/3	67/6
Rhodesian Broken Hill	15/3	11/7½
San Francisco Mines	31/6	20/6
Uruwira	8/9	4/5½
Miscellaneous Base Metals and Coal		
Amal. Collieries of S.A.	51/9	46/-
Associated Manganese	43/-	31/3
Cape Asbestos	12/6	8/9
C.P. Manganese	42/-	30/6
Consol. Murchison	3½	2½
Natal Navigation	62/-	51/3
Turner & Newall	118/1½	94/9
Wankie	19/9	16/-
Witbank Colliery	5¼	4
Canadian Mines		
Dome	$33½	$25
Hollinger	$54	$29
International Nickel	$169	$106
Mining Corpn. of Canada	£10¼	£6½
Noranda	$114	$73
Quemont	£10½	£7½
Yukon	4/10½	3/10½
Oil		
British Petroleum	6 5/8	3½
Apex	36/6	27/-
Attock	53/1½	38/9
Burmah	93/4½	51/10½
Canadian Eagle	59/9	33/9
Mexican Eagle	22/3	15/6
Shell	7 1/16	5⅛
Trinidad Leasehold	37/3	23/1½
T.P.D.	37/6	23/3
Ultramar	38/6	26/9

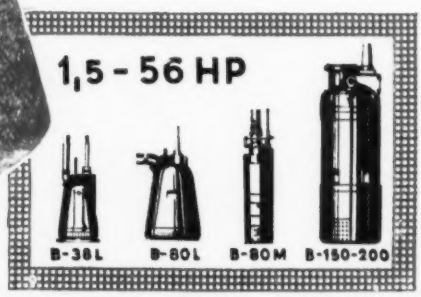
FLYGT

CONTRACTOR and MINING

SUBMERSIBLE
PORTABLE
ELECTRIC
} PUMPS



- fully portable and easily moved from place to place
- require no installation
- maintenance costs are very low
- flame-proof design
- needs no priming
- will run "on snore"
- designed to pump water containing a high percentage of solids



STENBERG CORPORATION AB

Duvedsvägen 17, Stockholm-Vällingby, Sweden

Representatives in : Great Britain • Holland • Belgium • France • Italy • Canada • India • Japan

Progress Report on the Mines

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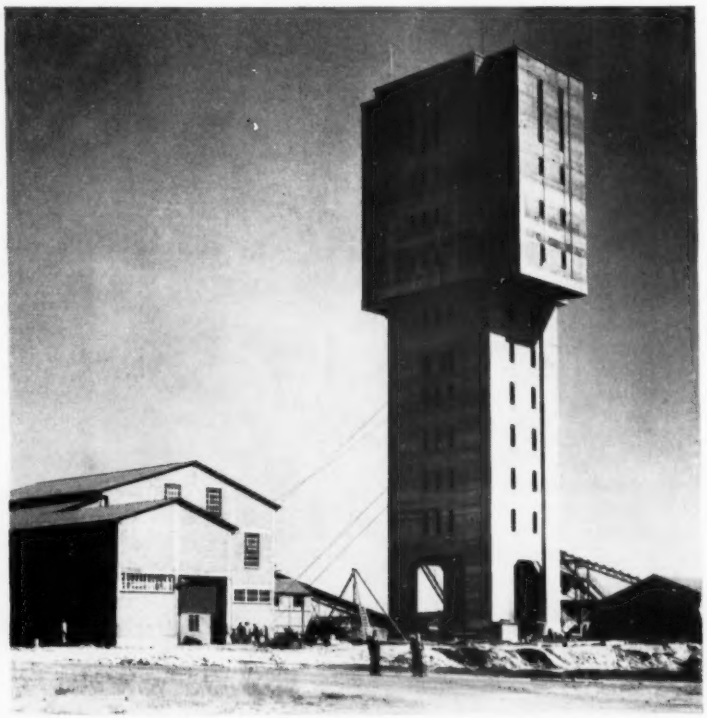
The Consolidated Gold Fields of South Africa, Ltd.

DURING the past year Consolidated Gold Fields of South Africa made an important addition to its widespread interests by the public flotation of its first potential Orange Free State gold mine under the title of the Free State Saaiplaas Gold Mining Company. This followed a systematic drilling programme on the ground concerned which lies immediately to the north of the Harmony Mine in the Virginia area of the O.F.S.

Consolidated Gold Fields, or "Gold Fields" as the company is familiarly known as, has a different structure from that of the other major mining finance houses. In order to give the group greater scope for its operations, the company formed many years ago a wholly-owned subsidiary called New Consolidated Gold Fields. It is this concern which conducts all the group's business. Gold Fields itself is now purely a holding company.



The No. 5 shaft concrete headgear and winder house at West Driefontein G.M.

In the year to June 30, 1955 dividends and interest on investments amounted to £1,468,000 and profit on realisation of investments to £286,000. Other revenue was reeceived by way of commission, fees, etc. Thus it can be seen that profits on realisation of investments, which depend to a large extent on the state of the South African gold share market, make up only a small part of the total revenue. By far the larger part of the company's revenue is derived from the more stable source of dividends.

The consolidated accounts showed a profit before taxation for the year to June 30 last of £2,353,000. A direct comparison with last year is not possible as exploratory expenditure written off is now charged to the investment and exploration reserve whereas it was previously charged to Revenue. The sum of £405,000 was placed to investment and exploration reserve, £207,000 to a general reserve and £52,000 to pensions. The Ordinary dividend was repeated at 17½ per cent, a rate to which it has steadily advanced from the 12½ per cent paid for 1949-50. The dividend was covered over two and a half times by earnings.

The consolidated balance sheet shows a strong position. Investments at June 30, 1955, had a book value of £10,806,000. Of these, £9,768,000 represented holdings quoted on Stock Exchanges either in London or abroad and the market value of these holdings at that date was more than double their book value at £23,413,000, a very impressive position. Current assets of £11,315,000 included £3,716,000 in cash and United Kingdom Treasury Bills, and £5,229,000 in deposits at call with the National Finance Corporation of South Africa.

Current liabilities amounted to £6,606,000 leaving net liquid assets (after deducting a provision of £353,000 for Income Tax 1956/57 and £555,000 provision for pensions) of £3,801,000. Taking the quoted investments at market value and the unquoted and fixed assets at book cost, and after deducting the outside shareholders' interests, a net asset value per ordinary share at June 30, 1955 of approximately £5 15s. 0d. is indicated after allowing for the preference capital.

Since the end of the last financial year Gold Fields has acquired the shares of another associated company, The Gold Fields Rhodesian Development Company Limited. Shareholders in that concern were offered one Ordinary £1 share in Gold Fields for every six shares of 10s in G.F.R.

In reviewing New Consolidated Gold Fields' assets it is of particular interest to note that at the meeting on December 8, 1955, the chairman, Mr. Robert Annan, revealed that 77 per cent. of the Stock Exchange value of the group's investments was still in gold mining, and that 94 per cent. of the investments in South African gold-mining, again based on Stock Exchange values, was in mines capable of producing gold at less than 150s. per ounce. This is an important point in these days of inflated mining costs.

Two particular examples may be taken from the group's mines to illustrate this point. In March, 1956, it cost West Driefontein, the group's large mine in the Far Western Rand, only 87s. 9d. to produce an ounce of gold worth 248s. 11d. At Robinson Deep, one of the deep old mines of the Central Rand, the cost was as high as 239s. 7d. The reason lies partly in the fact that Robinson Deep is drawing its ore from great depths, an expensive process, but largely in the big discrepancy between the respective gold contents of the ore. West Driefontein extracted 18.0 dwt. of gold from every ton of ore treated in March, 1956, a Rand record for large scale operations. The figure for Robinson Deep was only 4.3 dwt.

West Wits Line

West Driefontein is the richest and by far the largest gold producer of the four mines in the Gold Fields group in the Far Western Rand on what has become known as the "West Wits Line," a recognition that West Witwatersrand Areas was the Gold Fields Company which pioneered this extension of the Rand which stretches away for some 50 miles south-west of Randfontein. West Driefontein is milling 71,000 tons of ore monthly for a profit which reached a record of £518,111 in March. This represents an annual earnings rate of 17s. 8d. per share gross, that is to say before tax and lease payments and also not allowing for capital expenditure requirements which are still heavy.

With the mine only four years old so far as production is concerned, there are already two major shafts completed and three more in progress. This indicates that the present official milling target of 100,000 tons per month is far below that which will eventually be attained. In addition, production of uranium is scheduled to start during 1956.

Immediately to the west of West Driefontein comes the Blyvooruitzicht mine, in which Gold Fields has a substantial investment, and which is under the administration of the Central Mining group. Doornfontein, which lies immediately to the west of Blyvooruitzicht, and which is under the administration of Gold Fields, started gold production in November, 1953. It has since attained a milling rate of about 57,000 tons monthly, the profit for March, 1956, being just over £88,000. The present monthly crushing target is 100,000 tons. Doornfontein is not as rich as West Driefontein, but its cost per ounce of gold produced is already down to 173s. Gold recovery per ton in March, 1956, was 8.1 dwt.

Mechanical Sorting

As in the case of West Driefontein, Doornfontein is adopting a system of mechanical sorting for which the soft Carbon Leader reef is particularly suitable. This sorting raises the cost per ton of ore treated, but the discarding of waste rock means that the gold yield per ton from milling is considerably improved and profits are thereby enhanced. Something like 30 per cent of the rock is at present being discarded as waste by this method. Doornfontein has not yet obtained the maximum advantage from sorting, but it is notable that the gold recovery per ton in March, 1956, of 8.1 dwt. compares with the average value of the ore reserves as at June 30, 1955, of only 6.8 dwt. The tonnage of the reserves at that date was 1,008,000 tons, a figure which should have been materially improved upon since, while the grade should also have risen owing to the better development values that have been met with during the current financial year. Doornfontein is due later this year to start contributing uranium-bearing slimes for treatment at the West Driefontein plant, but it has been officially forecast that the full effect of this on operating results is unlikely to be seen for " some months thereafter ".

Although mining prospects in the western part of Doornfontein's large property of 6,486 claims is still unknown, the eastern half of the property alone will provide a life of 30 to 40 years and it is naturally intended to concentrate on this particular part of the mine. It will also presumably be possible to extend the property southwards. Doornfontein is in a different position in this respect from that of Blyvoor and West Driefontein. All the ground along the southern boundary of Blyvoor and along about two-thirds of that of West Driefontein comes in the area which may be floated off in due course as a deep-level mining proposition under Anglo American Corporation auspices. West Driefontein has an 18¾ per cent interest in the vendor consideration and will be entitled to 30 per cent subscription rights at par in any company formed to work this deep-level ground where the Carbon Leader is upwards of 1½ miles below the surface.

Doornfontein's earnings are currently running at a rate equal to 2s. 2d. per share per annum before loan interest and before taxation for which there is as yet no liability. Owing to the continued heavy capital expenditure, however, a maiden dividend is unlikely before the financial year ending on June 30, 1957. Capital expenditure will then be on the decline and increased output should be swelling earnings materially.

In the year to June 30, 1955, the five mines of the " West Wits line," namely West Driefontein, Doornfontein, Blyvoor, Venterspost and Libanon, made working profits of £13.4 million, which was as much as 25 per cent of total South African gold and uranium mining profits for that period. The West Witwatersrand company holds approximately 18 per cent of the Ordinary capital of the companies concerned. West Wits is also still drilling the large area which lies to the south-west of Doornfontein. It looks as though the Carbon Leader will not be an economic proposition here, but there are hopes concerning the Main reef as well as certain shallower reefs.

Gold Fields' First Orange Free State Mine

Gold Fields' first potential Orange Free State gold mine is the Free State Saaiplaas Gold Mining company. A lease has been obtained from the Government of 4,920 claims situated immediately to the north of the Harmony mine in the Sand River area which lies in the south-eastern part of the O.F.S. gold field as at present established. Free State Saaiplaas has an issued capital of £6,067,559 in 10s. shares, all of which were issued at par last year. The participating companies were headed by New Consolidated, Free State, Exploration company, a Gold Fields Group Company which also has a substantial interest in the Harmony mine. The shares of N.C.F.S.E. are not quoted on the Stock Exchange either in London or Johannesburg. Other companies concerned were Middle Witwatersrand (Western Areas), South African H.E. Proprietary, New Free State Gold Estates, New Witwatersrand Gold Exploration, and Lydenburg Estates. Shareholders in these concerns were offered Free State Saaiplaas shares at par in varying proportions. In the case of South African H.E. Proprietary the shares were offered to holders of the parent company, H.E. Proprietary. The largest single holder of Free State Saaiplaas shares is the New Consolidated F.S. Exploration company which retained 1,896,580 shares.

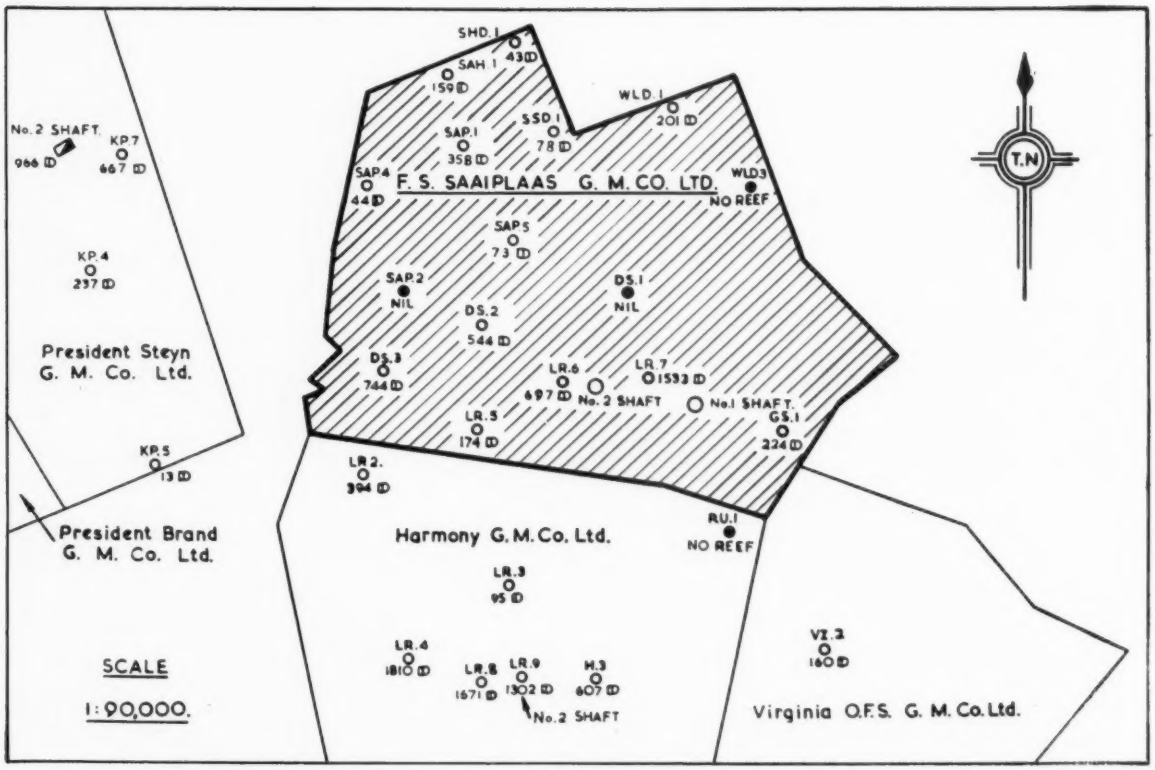
In the Free State Saaiplaas prospectus it was estimated that the initial working capital of £5.5 million would, after paying expenses and expunging certain liabilities incurred prior to the company's formation, be sufficient to sink two shafts to a depth of about 6,000 feet, which should take about 3½ years to complete from the start of sinking operations, preparation for which is now in progress. A further £6.2 million would be required to bring the mine to production at a rate of 50,000 tons of ore per month some six years after the start of shaft-sinking. The initial shaft system has been designed to support a milling capacity of 125,000 tons monthly.

The prospectus gave an estimate, culled from the borehole results, of the mine's tonnage possibilities. This was put at approximately 52 million tons of Basal reef " of an average value which amply justifies the relatively high capital expenditure that will be required to exploit the area and establish a successful producing mine ". As may be seen, on a monthly tonnage of 125,000 this would give to the property a potential mining life of about 35 years.

The property has been drilled by 17 boreholes with 48 deflections totalling 113,612 feet of drilling. The Basal reef main horizon lies at an average depth of about 6,000 feet, but there are also other reefs which may have economic possibilities. The average inch-dwt. obtained from the various boreholes, including deflections, are shown in the accompanying map. Faulting and water problems are not expected to be serious. The khaki shale which overlies the Basal in some parts of the Orange Free State and constitutes something of a mining problem owing to its softness is expected to be present over only 60 per cent of the lease area and is generally thin so that it is not likely to be a serious handicap to reef extraction.

The next big step forward in Free State Saaiplaas from the shareholders' viewpoint will be the start of underground reef development, probably in 1959. With all its three neighbouring mines, President Steyn, Harmony and Virginia, scheduled as uranium producers, Free State Saaiplaas is also expected to come into the picture in this respect. The consulting engineers have,

The picking belt with electro-magnet in operation at Doornfontein G.M.



The area occupied by Free State Saaiplaas G.M. Co. Ltd., showing also its position in relation to the three neighbouring mines, all scheduled as uranium producers

in fact, expressed the opinion that the mine is potentially an economic source of uranium.

Native Training

Besides Free State Saaiplaas the Gold Fields group has eleven producing mines on the Rand. It is consequently concerned with the scarcity of labour which is a problem of the industry as a whole. The group has been in the forefront of the move towards increased underground mechanisation in order to make the greatest possible use of the manpower available. It has also adopted what is known as the "Training within Industry" scheme for both European and African employees, and has special schools in which the modern techniques of underground work are simulated as closely as possible.

This kind of tuition is obviously of particular importance so far as the native workers are concerned, especially as the seasonal rise and fall in the supply of this class of worker makes speedy instruction of new recruits an essential part of overall labour efficiency. The inculcation of safety methods naturally ranks high in the initial tuition. This is not left to mere words. An explosive blowing a clay hand off a dummy miner leaves much more of an impression on the mind, simple or otherwise. Rhythmical singing of words and terms, together with a kind of Esperanto, known as Fanakalo, to create a common language among the multi-lingual tribes is a part of the course. Later on, after they have become acclimatized to underground work selected natives undergo further training with the object of becoming Boss Boys.

In the training of Europeans it is never forgotten that although he may not be a mine official the white worker is a supervisor so far as the African workers are concerned. The basic principles of supervision are therefore a "must".

FINANCIAL RESULTS

(for the last two complete financial years)

COMPANY (*Year to Dec. 31 except where otherwise noted*)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS* £(000)								*Capital Expenditure* £(000)†		*DIVIDENDS PER SHARE*			
		Working Profit		*Uranium Profit*		*Taxation and/or Mining Lease*		*Net Profit After Tax*				*Paid*			
												1955-54		1954-53	
		1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	*June* s. d.	*Dec.* s. d.	*June* s. d.	*Dec.* s. d.
Doornfontein *c*§‡	9,828,000 (10/-)	1020·3	450·5	—	—	—	—	928·9	405·9	917·1	975·2	—	—	—	—
Libanon §	7,937,300 (10/-)	652·8	583·6	—	—	—	—	636·5	569·2	255·8	480·2	3	3	3	3
Luipaards Vlei §‡	4,969,105 (2/-)	472·2	518·1	133·6	—	9·1	8·2	539·7	497·3	17·4	96·2	7½	7½	7½	7½
Rietfontein C.	1,122,252 (5/-)	237·4	280·1	—	—	121·5	136·9	117·6	140·6	Cr2·3	9·7	1 1	1 2	1 3	1 3
Robinson Deep ..	2,000,000'B'(7/6)	216·9	338·9	—	—	5·7	153·3	254·5	203·9	40·1	28·8	1 6*e*	1 6*e*	1 3	1 9*a*
Simmer	6,750,000 (2/6)	206·9	173·0	—	—	22·7	9·3	227·2	186·6	6·1	24·4	4	5	3	5½*b*
Sub Nigel §	1,771,875 (10/-)	1099·0	1205·6	—	—	532·9	542·6	601·6	665·4	13·0	11·0	3 6	3 6	3 9	3 9
Venterspost §	4,900,000 (10/-)	792·0	713·2	—	—	171·9	80·8	592·6	590·2	404·0	436·3	6	6	5	5
Vlakfontein	6,000,000 (10/-)	872·0	867·5	—	—	327·4	315·9	550·0	547·7	189·0	163·2	8	8	6½	7½
Vogels ‡	5,028,571 (10/-)	1344·0	1323·9	439·8	—	553·0	238·8	1151·1	1045·6	44·8	31·9	1 7½	1 8	1 6	1 6
W. Drie §‡	7,041,080 (10/-)	4267·8	3303·7	—	—	1290·1	902·5	2928·9	2373·1	1657·4	1503·5	2 3	1 9	1 3	9

• Calculated on stope width † Excludes uranium capital expenditure ‡ Scheduled uranium producer *a* Includes 6d additional payment *b* Includes 1½d additional payment *c* 1954 figures relate to 8 months' operations only. *d* Production statistics relate to Main Reef Section only *e* Including 3d additional payment. § Figures shown are for the Years ended June 30, 1955 and 1954 respectively.

The success of Gold Fields' efforts is shown by the fact that labour productivity in its group of South African gold mines has increased by 21 per cent overall and by 38 per cent underground during the past nine years.

Gold Fields Stake in Platinum

Apart from its gold and uranium producers in South Africa, Gold Fields also has a stake in the rapidly expanding platinum mining industry through its holdings in the Waterval (Rustenburg) Platinum Mining and Union Platinum Mining companies. Waterval holds directly 39 per cent of the capital of Rustenburg Platinum Mines which is the producing company. It also holds further indirect interests in Rustenburg through shareholdings in Potgietersrust Platinums and Union Platinum Mining which two concerns hold the balance of the Rustenburg capital, the Union Company having 17.5 per cent.

Rustenburg, one of the world's largest producers of platinum, has completed one major expansion programme (production has quintupled during the past ten years) and is now embarking on another designed to increase output by a further 50 per cent. This is considered to be justified owing to the rising demand for the metal in modern industrial processes. About 90 per cent of platinum consumption is now for industrial purposes as distinct from the jewellery trade. The price of the metal has improved to £34 per ounce. A year ago it was £29.

Rustenburg Platinum shares, being wholly-owned by the three participating companies, are for this reason not dealt in on the Stock Exchange. Some idea of their value is given by the fact that to finance the new expansion programme 60,600 £1 shares have been issued in 1956 at £17 per share, raising the capital to £868,600. The holding companies are in turn raising the necessary funds to take up these shares by offering shareholders new shares pro rata. All four companies pay regular dividends.

Other Interests in Africa

In other parts of South Africa, Gold Fields has existing interests apart from various exploratory projects. The absorption of Gold Fields Rhodesian has widened the stake in Rhodesia including that in the Motapa Gold Mining Company. In Tanganyika the Company also has an interest in Geita Gold Mining Company, to which New Consolidated Gold Fields acts as Technical Advisers. In West Africa closure of the long-established Taquah and Abosso mine was precipitated by the prolonged strike of African labour which hit all the mines of this region from mid-November, 1955, until end-February, 1956. Gold Fields' other interest here, Konongo Gold Mines, has made a capital return of 1s. per share and is absorbing the adjoining Lyndhurst property in which Gold Fields also has a shareholding.

Exploration for Radio Active Minerals

The radio-active minerals of the "new age" as well as base metals are the targets of considerable exploration by Gold Fields in the territories of Central and East Africa, with a view to opening up new mineral deposits and to re-investigating known deposits which, in the light of modern economic and transport conditions and as a result of advances in methods of mineral extraction, may have become economic mining propositions. Gold Fields is carrying out its exploration work with the most modern equipment available, and is making extensive use of airborne prospecting instruments. A company called Chartered Exploration in which Gold Fields has acquired an interest has been formed by the British South Africa company and the Anglo American Corporation of South Africa to prospect a large area in Northern Rhodesia. Another company, New Consolidated Prospecting (Pty) has been formed by Gold Fields to prospect in Northern Rhodesia (under an agreement with Mwinilunga Mines, one of the Rhodesian Selection Trust group).

Australia

In Australia, Gold Fields has a substantial stake in Lake George Mining Corporation which since the prolonged labour strike ended on February 1, 1955, has continued production of lead-zinc and copper without interruption. With the current high level of metal prices a return to the dividend list by Lake George is expected for the year to June 30, 1956.

Another Gold Fields' interest in Australia is the long-established Lake View and Star gold mine, which is a consistent dividend-payer and during the past three years has been able to effect a steady reduction in the cost per ton of ore treated. This reduction is a noteworthy performance in a period when mining costs generally have been rising in line with the general inflation that has marked the economies of most countries during this period. Lake View's costs have thus been reduced in the face of rising prices of stores and equipment and successive increases in mining wages.

America

In America Gold Fields is represented by its wholly owned subsidiary, the Gold Fields American Development Co., which owns the entire share capitals of Tri-State Zinc Inc., a base metal producer, and Buell Engineering Company. In Canada the Yukon Consolidated Gold Corporation comes within the Gold Fields group. This company produces gold from dredging operations during that part of the year (some six months) when work is possible on its properties in the Klondyke. Eight dredges are owned and regular dividends are paid.

Canada

Recently, a new wholly-owned Canadian subsidiary company, New Consolidated Canadian Exploration Limited has been formed by Gold Fields American Development in Toronto with the object of furthering the Group's exploration and mining activities and interests in Canada.

Oil

Gold Fields also has an interest in oil through share-holdings in Apex (Trinidad) Oilfields, Trinidad Leaseholds and Ultramar *

DEVELOPMENT AND MILLING RESULTS

(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	TOTAL ORE RESERVES As at last report		DEVELOPMENT RESULTS						MILL THROUGHPUT															
			Ft. Sampled (000)		Payability				Tonnage				Gold Recovered						Working Profit					
					%		Av. Value* (In.-dwt.)		Tons Milled (000)		Cost per Ton		Ounces (000)		Yield (dwt./ton)		Cost per ounce		Per ton		Per oz.			
	Tons (000)	Value (dwt)	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954		
Doornfontein *c* §‡	1,008	6·8	10·6	14·5	93	74	368	353	598	379	55/10	50/11	214·4	113·9	7·2	6·0	155/8	169/4	34/1	23/9	95/2	79/1		
Libanon §	2,395	4·5	17·8	26·1	72	66	270	304	1191	1081	41/9	40/3	250·1	221·4	4·2	4·1	198/8	196/8	10/11	10/10	52/2	52/9		
Luipaards §‡	2,248	4·4	19·6	33·4	60	60	252	244	1228	1285	42/-	38/10	243·1	241·6	4·0	3·8	212/-	206/7	7/8	8/1	38/8	42/11		
Rietfontein C. *d*	339	5·1	6·5	8·3	33	53	344	522	317	329	41/10	39/5	71·7	74·4	4·5	4·5	184/11	174/8	14/11	17/-	66/3	75/4		
Robinson	1,076	4·4	3·9	5·5	57	44	340	471	983	1185	49/6	46/8	210·9	248·8	4·3	4·2	230/8	222/6	4/5	5/9	20/7	27/3		
Simmer	1,143	4·2	20·2	26·4	47	37	249	270	1422	1496	39/3	38/3	238·8	243·0	3·3	3·2	234/-	235/6	2/11	2/4	17/4	14/3		
Sub Nigel §	1,219	7·9	33·1	35·0	29	26	347	341	795	795	54/3	52/3	259·7	263·3	6·5	6·6	166/3	157/10	27/8	30/4	84/7	91/7		
Venterspost §	2,832	5·4	21·3	31·4	59	48	353	359	1314	1299	49/2	47/1	320·8	302·2	4·9	4·6	201/7	202/4	12/1	11/-	49/5	47/2		
Vlakfontein	1,504	8·3	27·5	28·1	42	44	357	372	465	463	54/7	52/3	170·6	166·6	7·3	7·2	149/-	145/3	37/6	37/6	102/2	104/2		
Vogels ‡	2,885	5·4	27·3	29·2	35	34	230	272	1235	1229	43/3	42/2	318·4	312·6	5·1	5·1	167/8	165/11	21/9	21/7	84/5	84/8		
W. Drie §‡	1,096	16·5	17·2	15·2	100	100	802	840	713	558	71/5	65/8	543·0	411·7	15·2	14·7	93/10	89/-	119/9	118/3	157/3	160/6		

* Calculated on stope width. † Excludes uranium capital expenditure ‡ Scheduled uranium producer *a* Includes 6d. additional payment *b* Includes 1½d. additional payment *c* 1954 figures relate to 8 months operations only. *d* Production statistics relate to Main Reef Section only *e* Including 3d additional payment.
§ Figures shown are for the years ended June 30, 1955, and 1954 respectively.

Anglo American Corporation of South Africa, Ltd.

DURING the past quarter of a century a vast expansion has taken place in the mineral development of Southern Africa. In this time a new gold field has been founded in the Orange Free State and valuable extensions made to the existing fields of the Western Transvaal. The Copperbelt in Northern Rhodesia has been developed to its present position of that of a major world producer; diamond output has been stepped higher and higher; and uranium production has become a vital new industry. In all this and much more, no single organization has made a bigger contribution than the Anglo American Corporation of South Africa of which Sir Ernest Oppenheimer has been chairman for so many years. Such great contributions as have been made by the Corporation to the mining industry in all its branches would not have been possible without the building up of an immensely strong financial position over the years and although this process was inevitably retarded during the war, successive balance sheets have shown a remarkable expansion in resources in more recent years.

THE ROLE OF A FINANCE HOUSE

It is one thing briefly to describe the Corporation as a mining finance house—which it certainly is. But such a bald description does faint justice to the magnitude and scope of the undertaking's financial and technical activities. There is, on the one hand, the vast organization which has been created at all levels from policy-making downwards in both technical and financial spheres in order that the Corporation may carry out its role of consulting engineers and secretaries to the great number of companies operating in the Anglo American group. On the other, there has been the creation of financial machinery which, particularly in the post-war years, has become necessary not only to the Corporation's own progress but equally to the many new mining ventures in Southern Africa which have been brought to fruition, or are being developed, under the aegis of the Corporation. Thus to a not inconsiderable extent Anglo American has increasingly been assuming the role of merchant banker and this is an aspect of the group's activities which is likely to be of growing importance.

Examination of the Anglo American balance sheet quickly paints in much of the detail suggested by this introductory sketch. It should, perhaps, first be emphasized that although the Corporation may be given credit for having effective direct or indirect control over many companies operating in the group, the extent to which these are actual subsidiary companies is for an enterprise of its size, relatively limited. Thus, the Corporation's last published balance sheet covering the calender year 1954, while showing an asset total of £91,100,000, compared with £67,000,000 a year earlier, accounted for only £7,300,000 in respect of subsidiary undertakings. Other investments, a preponderance of which, of course, relates to ventures in the group, accounted for as much as £27,000,000, this being substantially the same as in the previous year. Of this total, it may be noted, quoted shareholdings figured at £19,500,000 but had a market value of no less than £56,300,000. The balance of total assets, amounting to £56,600,000, was accounted for by current assets, the great bulk of which were in the form either of loans to affiliated companies or in cash. At the same time, and reflecting the growth of inter-company financing within the group there were current liabilities reaching £54,200,000 of which £45,200,000 represented loans made by affiliated and other companies. The ensuing net liquid assets amounting to some £2,500,000 could be deemed a no more than prudent figure bearing in mind the demands for fresh finance constantly being made. Because of the relatively moderate holdings in subsidiary companies, *per se* it will be found that the consolidated balance sheet presented by the Corporation varies from that of the parent undertakings to a smaller extent than is frequently seen in enterprises of this magnitude. However, as at December 31, 1954, group net liquid assets totalled £3,100,000 and total investments (book figure) £32,000,000.

In recent years, Anglo American has given the impression of being half-reluctant to step up the annual dividend rate beyond what it could reasonably expect at least to maintain in subsequent years. However this may have been due to policy, it has also been very obvious that the Corporation has, in the past decade or more, always been in the position of necessarily conserving funds to a more than ordinary extent. Ten years ago the annual distribution rate was 40 per cent. This has since been increased to 60 per cent in 1949 and 70 per cent in 1954, the latter rate having been maintained in respect of the twelve months to December 31, 1955. A preliminary statement for the past year has announced profits, subject to final audit, of £5,000,000 after taxation compared with £4,000,000 in 1954, £1,000,000 having been transferred to general reserve, £500,000 taken for provision against loans and £549,000 written off investments.

It is against this kind of financial background that a more detailed consideration of the Anglo American group's mining activities can be given. Few mining fields exist in Southern Africa in which the Corporation does not hold a stake. Through the unique connection with De Beers Consolidated Mines, and in particular through Anglo American Investment Trust with its predominantly diamond investment portfolio, a substantial stake is held in the fortunes of the diamond industry (see page 253). As is shown in the review of the position on Rhodesian Anglo American (page 284) the Corporation has both directly and indirectly become heavily identified with the base metal producers of Northern Rhodesia and all indications are that this interest will continue to grow with the expansion of the industry itself. Apart from Wankie Colliery in Southern Rhodesia, the rehabilitation of whose productive capacity has been a notable feature of Anglo American management since 1953, the Corporation through the African and European Investment Company can boast of a large share in the control and management of the South African coal mining industry, as is emphasized later in this article. In other directions new prospecting is in hand not only for commonly known metals but for rare earths and other "new" minerals.

It is, however, more particularly in the Orange Free State, where a wholly new gold field has been brought into being within the past decade, that the group has been conspicuously ambitious. It has been estimated that a capital investment of the order of £200,000,000 has so far been required to bring the O.F.S. goldfield to its present comparatively advanced stage. There have been disappointments and much remains to be done. No bigger part has been played than that of Anglo American with its control and direction of six out of a total of twelve O.F.S. mines which have been publicly floated.

FINANCIAL RESULTS (*for the last two complete financial years*)

COMPANY (Year to Dec. 31 except where otherwise noted)	ORDINARY SHARES IN ISSUE	PROFIT AND LOSS RESULTS £(000)								Capital Expenditure £(000) †		DIVIDENDS PER SHARE			
		Working Profit		Uranium Profit §§		Taxation and/or Mining Lease		Operating Surplus				Declared			
												1955		1954	
		1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	Int'm(c) s. d.	Final s. d.	Int'm(c) s. d.	Final s. d.
Brakpan	4,600,000 (5/-)	173·9	173·8	—	—	19·4	16·4	224·6	231·5	2·2	—	4½	7½	4½	6
Dagga ‡	7,000,000 (5/-)	3656·0	3774·5	1682·0	1377·8	2827·5	2569·2	5293·2	5070·3	55·0	19·6	2 9	3 0	3 0	3 0
East Dagga	3,730,000 (10/-)	525·8	552·6	—	—	242·1	253·3	537·6	559·5	—	Cr 0.5	9	10½	9	9
Loraine § *b*	16,453,372 (10/-)	Dr 186.6	—	—	—	—	—	Dr186·6	—	1322·9	2907·8	—	—	—	—
P. Brand ‡§	13,000,000 (5/-)	2358·2	532·4	148·8	—	—	—	2385·4	532·2	882·7	2189·2	1 0	—	—	—
P. Steyn ‡ §	13,000,000 (5/-)	1052·9	375·3	235·3	—	—	—	970·0	375·4	339·2	1240·3	9	—	—	—
S.A. Lands	2,475,000 (3/6)	628·4	667·2	—	—	278·7	286·7	645·5	680·7	17·7	25·4	1 4½	1 6	1 3	1 6
Springs	10,110,000 (5/-)	121·1	92·6	—	—	15·7	8·0	122·4	101·0	Cr. 70.1	Cr 5.3	—	5½*a*	2½	—
Welkom ‡ §	12,250,000 (5/-)	96·4	83·9	—	—	—	—	—	83·5	441·5	494·4	—	—	—	—
Western Hldgs. ‡§	7,496,376 (5/-)	1255·2	910·8	—	—	—	—	1179·9	915·7	448·8	751·3	1 6	—	—	—
Western Reefs	7,000,000 (5/-)	634·6	800·3	1627·7	1415·8	455·5	8·2	2127·1	2083·8	383·8	86·0	1 3	1 3	1 3	1 3

† Excludes Uranium capital expenditure ‡ Scheeuled uranium producer § As financial year end changed to Sept. 30 from Dec. 31, figures for 1955 reflect 9 months operations only against the previous 12 §§ No allowance made for redemption of, or interest on, uranium loans

(*continued on next page*)

FREE STATE GEDULD—THE MARKET LEADER

Of all the mines so far formed in the O.F.S., none has been the subject of greater hopes than Free State Geduld which was formed under the auspices of the Corporation in 1947. The ground now comprising the Free State Geduld lease area had already come into prominence by reason of two phenomenally rich bore-hole strikes in the previous year on what is now the common boundary with Western Holdings lying to the south. The high values disclosed in these two holes, together with the above average results derived from drilling nearby holes has lead to the supposition that in the considerable area occupying the southern half of Free State Geduld and, to a lesser extent, the northern part of Western Holdings, the Basal reef, the chief gold-carrier in the Free State, would contain values of a very high order. The time involved in bringing Free State Geduld to a position sufficiently adequate to confirm these impressions has been delayed well beyond original expectations. It was found that the mine contained considerable quantities of underground water and intensive faulting has been experienced from time to time. The past year has seen much achieved in the ironing out of these problems and in bringing the mine not only to the stage of gold production but to a point where an expanded development policy has become more practical.

Hitherto, the greater part of underground development has been done in the No. 1 shaft area in the more north-westerly part of the property. This area, though highly economic under present gold mining conditions, is nevertheless likely to be of appreciably lower grade than the ground lying farther to the south. Recent development in the No. 1 shaft area has, in fact, been giving values above those previously obtained. Development continued on all levels from a depth of 4,500 ft. to 5,300 ft. and during the nine months to September 30, 1955, a total footage of 5325 ft. were sampled from No. 1 shaft with a payability of 89.4 per cent and average in.dwt. figure of 531. Since that time, 1,480 feet have been sampled in the December quarter with 85.1 per cent payability and 534 in.dwt., and a further 1,185 feet were sampled in the March quarter of this year of which 97.5 per cent were payable having average values of 675 in.dwt. The more recent policy is to speed up development in the south and south-west of the No. 1 shaft where two high borehole values have already been obtained.

Meanwhile, heavy water-bearing fissures have considerable retarded the opening up of the southern part of the property from the No. 2 shaft, a particularly bad inrush being encountered on the No. 47 level in the middle of 1955. Until this time there had been every reason for hoping that the mine could reach production before the end of 1955 by drawing ore from stopes established at the Nos. 1 and 2 shafts. The inrush of water at No. 2 shaft made this programme impracticable but labour was transferred to the No. 1 shaft where sufficient stope faces were opened up to permit the official start of production in January, 1956. The company's first return in respect of this month announced a crushing of 33,000 tons for a gold recovery of 10,801 oz. (6.55 dwt. per ton), working costs of 69s. 7d. per ton and an initial working profit of £20,168.

In all respects figures of this sort—there has since been a gradual improvement—cannot be considered as anything approaching what might be deemed as representative of the mine as a whole when more adequate stope faces have been established, and it is possible to undertake development from both shafts on a more balanced scale than hitherto.

It is here that the importance may be assessed of the development which has already been accomplished in the No. 2 shaft area, not only by Free State Geduld itself, but also from the sister company, Western Holdings. In order to speed up the exploitation of the common boundary area it was decided, some time ago, to extend the 41 haulage north from Western Holdings, and to expedite so far as possible the driving southwards of the 43 haulage from Free State Geduld. Difficult ventilation conditions in the first instance, and water problems in the second, have made this work a longer business than had been hoped. However, as at the end of March last, there remained only approximately 1,200 ft. to effect a holing between these two haulages and this was expected to be done sometime during the June quarter. With this achieved, it will not only be possible to speed up development in the areas as a whole, but will also make possible the drawing of ore from stopes near the Western Holdings boundary, for mill purposes before the end of the current financial year ending September 30, next.

The more immediate position is thus, that monthly results may be expected to improve gradually as a certain amount of No. 2 shaft ore becomes available. But, it will probably not be until the end of 1956 that it will be possible to assess the work that should then be in hand on several levels between Western Holdings and Free State Geduld. There have already been tangible indications of the sort of exceptionally high values that might be expected in normal development of this area. Sporadic development has been done from time to time where expedient in the area, and up to November 30, 1955, development into the Company's property from Western Holdings had totalled 1,075 ft. with 100 per cent payability, and average values of 1,837 in.dwt. At the same time, the 43 and 45 levels south of Free State Geduld No. 2 shaft had both intersected the reef giving 100 per cent payability with values of around 1,600 in.dwt. in each instance. Since that time, the March quarterly reports have shown Free State Geduld to have sampled 860 ft. in the No. 2 shaft area with 100 per cent payability, and in.dwt. of 1,062 and of this 305 feet were sampled on 43 and 45 levels, assaying 1,600 in.dwt. Meanwhile, holing through of the Nos. 1 and 2 shafts underground was achieved in January, 1956, and this, together with the connection with Western Holdings, should mean a considerably enhanced rate of mine development henceforth.

WESTERN HOLDINGS' RICH NORTHERN AREA

It has been seen that Western Holdings is by no means disinterested in the development situation concerning the southern part of the neighbouring Free State Geduld property. Conceivably, the northern part of Holdings will be a deal richer than the rest of the lease area. But meanwhile, Holdings is an altogether more established mine, having started production in July, 1953. Comparatively straight-forward mining conditions have been encountered in the area south of the No. 1 shaft and this has made possible the establishment of rapid stope connections. This factor has permitted the gradual stepping up of the milling rate which is now around 77,000 tons of ore monthly for an average yield of something like 8 dwt. gold per ton.

The mine's working profits have been enjoying a gratifying accretion in recent months and are now of the order of more than £180,000 monthly. Thus during the nine months to September 30, 1955 (the company's financial year, in common with those of other O.F.S. mines in the Anglo American group, has changed its year to this date) there was a net profit of £1,172,000, no tax liability yet ranking, out of which a maiden dividened of 30 per cent, or 1s. 6d. per share was declared on the £1,874,094 issued capital. An interim of the same amount has been declared for 1955-56. Two main factors emerge in

DEVELOPMENT AND MILLING RESULTS (*for the last two complete financial years*)

COMPANY (*Year to Dec. 31 except where otherwise noted*)	*TOTAL ORE RESERVES As at last report*		*DEVELOPMENT RESULTS*						*MILL THROUGHPUT*													
			Ft. Sampled (000)		*Payability*				*Tonnage*				*Gold Recovered*						*Working Profit*			
					%		*Av. Value* (*In.-dwt.*)		*Tons Milled* (000)		*Cost per Ton*		*Ounces* (000)		*Mill Grade* (*dwt./ton*)		*Cost per ounce*		*Per ton*		*Per oz.*	
	Tons (000)	*Value* (*dwt*)	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954
Brakpan	2,776	4·8	46·9	42·1	27	26	740	596	1283	1321	40/3	39/6	219·2	223·2	3·4	3·4	235/6	233/11	2/8	2/8	15/10	15/7
Dagga ‡	12,768	5·3	41·4	43·9	33	35	387	368	2658	2660	30/-	29/4	607·4	615·1	4·6	4·6	131/1	126/9	27/6	28/5	120/4	122/9
East Dagga	4,206	4·2	31·6	30·8	25	20	348	241	1146	1121	32/8	32/5	190·9	189·7	3·3	3·4	196/3	191/4	9/2	9/10	55/1	58/3
Loraine § *b*	509	4·0	14·2	11·8	57	73	296	284	184	—	57/11	—	27·6	—	3·0	—	386/9	—	Dr20/3	—D	r135/2	—
P. Brand ‡ §	1,573	18·1	8·9	11·9	89	94	1096	1420	394	168	69/2	71/5	295·6	90·4	15·0	10·8	92/2	132/9	119/8	63/5	159/7	117/10
P. Steyn ‡ §	2,524	8·5	12·4	17·0	82	91	532	657	651	436	53/2	57/2	221·2	129·9	6·8	5·9	156/7	192/-	32/4	17/2	95/3	57/9
S.A. Lands	3,679	5·6	34·2	41·3	41	39	451	553	1105	1213	36/8	34/11	211·5	223·6	3·8	3·7	191/9	189/7	11/4	11/-	59/51	59/8
Springs	2,346	4·8	18·5	22·8	26	34	360	565	1454	1522	30/9	33/7	187·5	212·6	2·6	2·8	238/4	240/7	1/8	1/3	12/1	8/8
Welkom ‡ §	2,355	5·9	15·7	22·4	74	77	421	460	715	863	47/2	49/2	141·5	176·2	3·9	4·1	238/5	240/8	2/8	1/11	13/8	9/6
Western Hldgs. ‡ §	2,273	10·8	10·9	14·7	86	86	734	833	594	591	51/1	59/10	220·3	214·8	7·4	7·3	137/9	164/9	42/3	30/10	113/11	84/10
Western Reefs	4,375	5·1	30·4	42·5	47	49	483	501	1411	1395	38/10	37/3	268·4	272·4	3·8	3·9	204/1	190/10	9/-	11/6	47/3	58/9

a Dividend enhanced by sale of surplus plant and buildings *b* Production started May 1955 *c* In the case of OFS companies for "interim" read "maiden"

the Western Holdings outlook. The first is the prospect in due course of an increase in the monthly tonnage of ore treated, plant capacity being already 125,000 tons, with a final extension to 150,000 tons in view. It is thought that 100,000 tons might be achieved by the end of 1956.

This in turn should bring down unit costs and meanwhile the possibility should not be overlooked of an improvement in the grade of ore treated, particularly if the northern area, as is hoped, turns out to be considerably richer than the mine's average so far. During the current year, the eastern section of the mine is to be explored by a long cross-cut on 43 level and meanwhile ore reserves (September 30, 1955) have been further increased to 2,273,000 tons averaging 10.81 dwt. gold per ton over a stoping width of 46.9 in.

It is sometimes overlooked that Western Holdings has investments to the extent of 315,827 shares in the adjoining St. Helena, besides a 480,000 share stake in Anglo American (O.F.S.) Housing and 342,000 shares in the presently dormant Jeannette Gold Mines adjoining the eastern boundary of Loraine at the northern end of the O.F.S. field.

PRESIDENT BRAND—BIGGER PROFITS FORECAST

If it may be thought that Anglo American in the Orange Free State is particularly and more spectacularly identified with F. S. Geduld and Western Holdings—and popular opinion suggests that it might be—others in the field belonging to the group are by no means humdrum ventures. Most notable is President Brand which is bounded on the west by St. Helena, on the north by Western Holdings and on the east by President Steyn. The present plant has a monthly mill capacity of some 75,000 tons and production started in August, 1954. Here, as on neighbouring mines, a higher output is ultimately scheduled and steps are currently being taken to put up the monthly capacity to 125,000 tons. During the past twelve months there has been a steady increase in the throughput although the 54,000 tons achieved in March were still below the plant's capacity.

So far, this has proved to be an extremely high grade mine —more-so in fact than might have been thought at the time of flotation in 1949. Development has consistently given payability of up to 90 per cent and since the start of development average gold values have been somewhere between 1,000 and 1,200 in.dwt. With increasing grade and production, monthly working profits have been mounting almost without a break during the past twelve months, and during the nine months to September 30, 1955, there were net profits, after negligible tax, of £2,375,000 from which a maiden dividend of 20 per cent, or 1s. per 5s. stock unit, was paid on the issued capital of £3,250,000. A first interim of 1s. 6d. per unit has been paid in respect of 1955-56, a final payment being due in September.

It may be worth remarking that development during the past year, satisfactory enough though it has been, has fallen a little short of the very exceptional figures obtained previously both as regards grade and payability. This has been at least partly due to the fact that recently comparatively little development has been done in the northern sections where there have been indications of the existence of particularly rich ore. The No. 2 shaft area, where more development has been undertaken, evidently covers lower grade ground. It was perhaps fortuitous that early stopes in the vicinity of the No. 1 shaft, from which ore has hitherto been mainly drawn, were in a very rich area. This meant, in fact, that ore above the average of the mine as a whole was being handled for mill purposes. It has been stated this year that now that the opening up of stopes has proceeded further a more balanced mining policy can be followed and the former problem of moderate overmining remedied. Thus, a slight fall in grade milled which in March was 15.9 dwt. against 16.03 dwt. in February, may now be considered likely as it becomes possible to mine lower grade areas. Such a decline, it is thought, is not likely to be serious, will most certainly be gradual and, because of the prospect of increased production, should not have the overall effect of preventing a further increase in profits. Considerable underground work is being involved in the necessary acceleration of development work in the No. 2 shaft area to meet increased tonnage requirements within the next year or 18 months.

PRESIDENT STEYN'S SOLID PROGRESS

Concerning the company's financial position, other than the already very satisfactory earning position, it needs to be added that the five per cent £1,250,000 loan from Welkom Gold Mining, which was simultaneously repayable *pro rata* with the declaration of dividends has, with the second payment declared in March, now been entirely discharged. This will, of course, release considerable additional funds for dividends henceforth so that a further increase in the third payment, due next September, may be fairly looked for.

The neighbouring company, President Steyn, has never claimed the glamour which high development values have so far given to President Brand. The mine's position is, however, by no means unsatisfactory when allowance is made for the comparatively high percentage of payability coupled with values which, if not spectacular, have at any rate been more than ordinarily economic from a gold mining point of view. The public flotation of President Steyn in 1948 actually preceded that of President Brand by a short period and on the basis of original borehole results alone it was possible at the time reasonably to take the view that, looking at the properties as a whole over what might be a forty-year life, there would not be much to choose between them—and into this comparison the nearby Welkom Gold Mining could also be included.

At September 30 last, President Steyn had an established ore reserve of just over 2,500,000 tons with an average value of 409 in.dwt., the tonnage having risen by nearly 750,000 tons during the preceding nine months with virtually unchanged values. As at neighbouring mines in the O.F.S., plans are in hand for an increase in production. Present milling capacity is 125,000 tons monthly and the treatment section is being expanded from its present capacity of 100,000 tons to this level. Milling at 100,000 tons is expected to be achieved by the last quarter of 1956. Financially, Steyn is in a somewhat similar position to that of President Brand in that there have been loan repayments to Welkom Gold Mining *pro rata* with dividend distributions. Part of the loan was thus extinguished when the company entered the dividend list in September, 1955, with a maiden payment of 10 per cent, or 6d. per share on the £3,250,000 issued share capital. A further loan instalment became payable with the first interim for the current financial year of 15 per cent, declared in March, and a similar dividend payment in September would extinguish the loan altogether.

Meanwhile, monthly profits on the basis of up to 88,000 tons of ore milled have been steadily increasing during the past year and are now running at around £190,000, for which a gradual improvement in the grade of ore handled has been mainly responsible. Reverting to the development position, it is worth noting that the building up of ore reserves to their present very satisfactory position has been the result of what might be called "excess" development. It is intended to continue this policy until reserves are in excess of 3,000,000 tons.

WELKOM — A SLOW STARTER

Welkom Gold Mining was the first of the Anglo American post-war flotations in the O.F.S. and until comparatively recently there has been room for disappointment with the showing which this mine has made. In this context, it has to be remembered that the company was first in this field in undertaking reef development and that much had to be learned empirically about such matters as reef faulting, underground water and other mining problems. Also, the mine in its early days was, perforce, operating under substantially poorer conditions generally than it has been the good fortune of the later O.F.S. mines to enjoy—such matters as housing and social amenities, the delivery of equipment and the like. The experience learned by Welkom and the other immediately post-war mines in the O.F.S. unquestionably has been of great value to the later projects. However, Welkom was brought modestly into production in November, 1951, being thus the first producer in the field together with the nearby St. Helena. Since that time production has suffered from a basic shortage of stoping ore which has meant some re-alignment of development policy during the past two years so that output, presently around 86,000 tons monthly, can match the plant's capacity of 125,000 tons and so that ore of a more representative grade, rather than development rock, can be handled. This long programme has now been showing signs of showing results.

Given adequate supplies it is now hoped that throughput will be increased to 100,000 tons monthly by the end of 1956. Meanwhile, ore reserves further increased by 460,000 tons to 2,355,000 tons as at September 30 last, the average value being 296 in.dwt. against 284 in.dwt. nine months earlier. While the mine's tonnage position thus looks to have gone a long way towards rectification, the average grade still remains comparatively low by O.F.S. standards generally although there is still a wide discrepancy on the "right side" between milling and ore reserve averages under this head. Any indications, therefore, that development was getting into better ground could be plainly taken as a vital matter in the mine's future and from recent development it appears this is happening.

In the final quarter of 1954 the value of payable development was 480 in.dwt., in the December quarter of last year there was an improvement to 450 and in the March quarter of 1956 a further advance to 519. Together with this im-

provement, there has also been a steady recovery in payability which averaged about 62 per cent in 1952, 64 per cent in 1953 and 77 per cent in 1954. The first two quarters of the current financial year have shown a further improvement first to 81 per cent and, in the March quarter, to almost 90 per cent.

Welkom's issued capital is £3,062,000 in 5s. shares on which no dividend has yet been paid. It should be emphasized that the repayment of loans made to the President Brand and Steyn companies, already referred to, is earmarked for the redemption of Welkom's 5 per cent debentures of which £4,000,000 were outstanding at the time of the last balance sheet (September 30, 1955). These debentures will now have been reduced to just under £3,000,000.

LORAINE — HOPES FOR THE "B" REEF

Loraine Gold Mines, formed in 1950, represents the last of the Anglo American group public flotations. The lease area lies at the northern end of the Free State field. Since development started, Loraine has not looked to be more than a moderate grade gold mining proposition and, after production started in May, 1955, steadily losses on operations have been incurred. these now amounting to around £24,000 monthly. It became apparent that gold recovery was not matching the grade expected from sampling and a re-sampling programme in stopes being currently mined led the consulting engineers to recommend a re-sampling of all Basal Reef development. It was subsequently found that for technical reasons peculiar to the mine itself Loraine development was not amenable to standard sampling practice and re-sampling on a new basis gave a lower payability with consequent reduction in assessed ore reserves which, at September 30, were just over 500,000 tons averaging 162 in.dwt. The current development programme aims at exploring ground where earlier drilling has indicated that a better trend of values might be found.

Meanwhile, although Basal Reef development has been comparatively disappointing, exploratory work on the "B' reef has given some surprisingly good results in the vicinity of the No. 2 shaft. Up to the end of November, 1955, 1,630 ft. had been sampled on this horizon of which 53 per cent were payable with an average of 751 in.dwt. and in the March quarter of 1956 3,390 ft. were sampled with a payability of 35 per cent and values of 820 in.dwt. Any prolongation of development of this calibre on this reef could clearly have an important bearing on the mine's overall position.

No review of the Anglo American group's wide activities in the Orange Free State could be complete without reference to the great new uranium producing industry which has grown up in the field side by side with the development and expansion of gold mining. The huge financial requirements in this matter have been met by loans granted through the Atomic Energy Board which have been arranged in conjunction with sales contracts lasting for a period of 10 years from the start of full production of the material. The loans are redeemable over this period at a price for uranium allowing the mines a fair margin of profits in relation to costs.

URANIUM PLANTS IN THE GROUP

The distribution of uranium in the O.F.S. occurs predominantly in the Basal Reef, the field's main gold carrier. On the other hand, its deposition varies considerably to the extent of being comparatively rich on one and of only uneconomic grade on another. Thus, not all gold mines in the O.F.S. or in the Anglo group are also uranium producers. But so far as the group is concerned, two uranium processing plants to handle slimes from the gold plants have been established—one at Welkom, the other at President Steyn. Both were commissioned towards the end of 1954, the Steyn plant treating slimes on its own account and for President Brand while the Welkom plant has been taking material from Freddies Consolidated.

During the current year material from this source will become exhausted and instead surplus slimes from President Steyn will be pumped to Welkom. Meanwhile, application nas been made by Loraine Gold Mines for acceptance as a uranium producer, the outcome of which is still awaited. Slimes from the Welkom gold plant have not yet been found sufficiently high in uranium content to warrant treatment for the recovery of this metal and the same has so far been true of Western Holdings and Free State Geduld. Quarterly profits from uranium alone have been running at about £105,000 in the case of President Brand and £168,000 in the case of President Steyn, before uranium loan redemptions.

WESTERN REEFS AND VAAL REEFS

While it is true that the O.F.S. in terms of gold mining has given a certain exceptional publicity to Anglo American Group operations in recent times, it must not be overlooked that in the same field the group has been no less active farther north in the Klerksdorp district of the Transvaal which may be taken, roughly speaking, as an extension of the Far Western Rand. Here, Anglo American has already been well established for a long time with Western Reefs Exploration and Development, a company whose extensive lease area lies immediately north of the Vaal river itself. Western Reefs, hitherto exploiting mainly a number of separate reefs in the Elsburg series, has been in production since 1941 and has been steadily building up production from around 900,000 tons yearly just after the war to rather more than 1,400,000 in 1955. This is still below the plant's rated capacity of 150,000 tons monthly. Western Reef's earning possibilities have not fulfilled expectations in recent times owing to the incidence of taxation rather than any technical reasons. However, an annual dividend of 60 per cent on the moderate issued capital of £1,750,000 has been forthcoming for the past six years and there appears reason for hope of an improvement in due course as the development of the Vaal Reef, as distinct from that of the Elsburg Reefs, takes a more important place in the mine's position. In 1955, a substantially increased footage was developed on this horizon and total ore reserves of 4,375,000 averaging 238 in.dwt. included more than 1,000,000 tons of Vaal Reef averaging 339 in.dwt. From this source it may be expected that increasing amounts of ore will be drawn which should at least offset, if not more, the expected decline in yield from the Elsburg reefs.

Western Reefs sister company, operating on the eastern boundary and the downward dip of the Vaal Reef, is Vaal Reefs Exploration and Mining which was registered in 1944 but which has had a long development programme because of the considerable depths down-dip at which mining in the lease area could start. Development has been facilitated by joint shaft arrangements initially made with the adjoining Western Reefs and has, since the start, consistently given Vaal Reef payability of approximately 85 to 90 per cent with average values ranging around the 600 in.dwt. mark. Vaal Reefs will be a deep mine but has so far been able to keep its issued equity capital down to £2,500,000—a modest figure in relation to the intended scope of the operation.

Both Western Reefs and Vaal Reefs are uranium producers. The former has been producing this material since the end of 1953 and the Vaal Reefs plant started both gold and uranium production officially on May, 1956. Western Reef's uranium profits have been running at about £250,000 per quarter after loan repayments and interest.

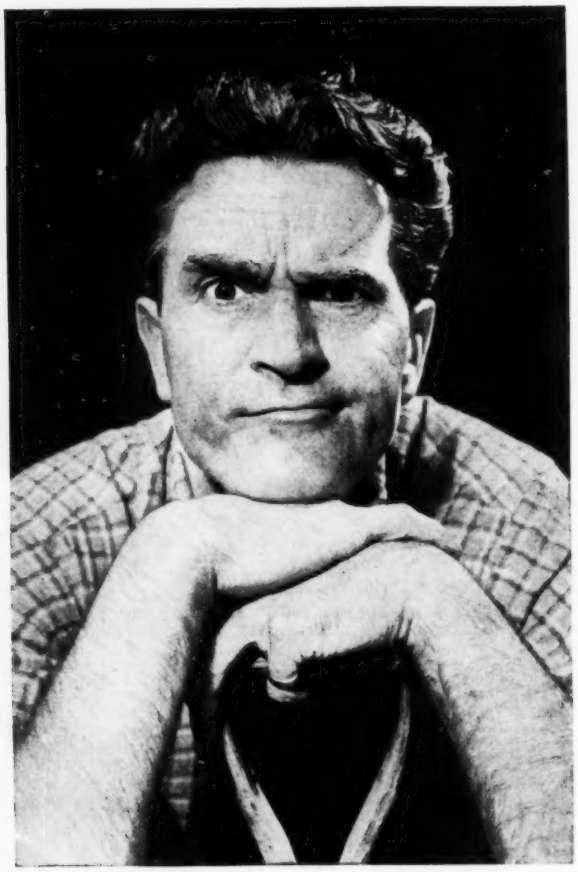
EAST RAND PRODUCERS

The Eastern Rand mines, mentioned earlier in this article, which fall under the aegis of Anglo American, have for many years been established gold producers. Outstanding among the number is Daggafontein which, in the early days, had two false starts before finally getting into permanent and successful production in 1932. Early production here was on the basis on the MainReef Leader but since the war the Kimberley Reef has also been exploited with some success, a 65,000 tons monthly plant being erected in 1949 at No. 4 shaft to handle ore from this horizon. Daggafontein has also been very much in the uranium picture, the Kimberley Reef being an economic uranium source on this property and the plant for this purpose started up in 1953. At Daggafontein, the old slimes dam is being exploited for uranium besides material from current production. Additionally, the company is working a sulphuric acid plant which supplies its own and some other acid needs of the Rand's uranium producers.

Brakpan as an old established mine, has been finding the maintenance of dividends difficult since the war, although payments for 1955 totalled 20 per cent, against 17½ per cent in 1954. However, they were at the rate of 42½ per cent in 1950 and 1951. Brakpan, now past its zenith, is a low-grade, low profit-per-ton earner and therefore considerable importance may attach to the much above average values which lately have been disclosed in the Footwall Reefs lying below the Kimberley Reef.

The progress of South African Lands and Exploration ("Sallies") a substantial shareholding in which is held by Brakpan, has been satisfactory in recent years. In 1955, dividends totalled 82 1/7th per cent on the 3s. 6d. shares against 78 4/7th per cent in each of the two preceding years. There has also been a steady improvement as to both grade and tonnage over the past several years.

Spring Mines represents an amalgamation of the company having the same name with West Springs at the beginning of 1948. The property must now be considered as approaching the end of its life, production having been started at the original Springs itself as long ago as 1917. Two single payments of 3¼ per cent and 8¼ per cent were paid for 1954 and 1955 respectively.



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BRITISH OVERSEAS AIRWAYS CORPORATION

De Beers Consolidated Mines Ltd.

WORLD diamond sales in 1955 reached the record total of £74,288,695. This compared with £62,153,125 for 1954 and with £69,661,926 for 1952, the previous highest. The term "world" in this context covers the stones handled through the Central Selling Organisation of the De Beers group of companies. And this in turn means that some 95 per cent of world production is marketed through this single channel, the ruling force of which is the Diamond Corporation in which De Beers Consolidated Mines and its subsidiary, Consolidated Diamond Mines of South-West Africa, together hold an 82 per cent interest, the other 18 per cent being held by Anglo American Corporation of South Africa's diamond finance company, Anglo American Investment Trust.

The Diamond Corporation may, perhaps, be aptly described as a benevolent autocracy; its suppliers — outside De Beers' own mines in South Africa — willingly participating in marketing arrangements on contracts negotiated every five years. In March of this year the contracts were renewed until December 31, 1960. The companies concerned are Companhia de Diamantes de Angola, Société Minière du Beceka, Société Internationale Forestière et Minière du Congo, Sierra Leone Selection Trust, Consolidated African Selection Trust, Société Guinèenne de Recherches et d'Exploitations Minières, Akim Concessions and Williamson Diamonds.

ENORMOUS RESOURCES

As may be seen, this is an international assortment. It is drawn together by the obvious advantages that a central selling organisation can offer in the way of stable prices, guaranteed minimum sales and orderly marketing through periods of boom and slump. In the past few years the Diamond Corporation's main problem has been to find enough stones to satisfy demand. It is when less buoyant trading times come along that the diamond producers reap the real benefits of their united sales arrangements. This is especially so now when the De Beers Organisation through a long run of prosperity has been able to build up an almost impregnable financial position with which to face less prosperous conditions. The balance sheet total of De Beers' consolidated accounts at December 31, 1955, was no less than £139,000,000.

With its enormous resources it is only natural that the company should have begun to widen its interests in order to become not entirely dependent on a commodity the demand for which is essentialiy a volatile one. Thus De Beers has branched out into the rapidly expanding explosive and chemical industries in South Africa and has also played a substantial part in financing the new Orange Free State gold field in South Africa. The subsidiary De Beers Industrial Corporation, formed in 1944, directs the industrial side of the business. De Beers has a 71½ per cent stake in this Corporation which has numerous interests, the principal amongst which is a 50 per cent holding in African Explosives and Chemical Industries. The other 50 per cent is held by Imperial Chemical Industries. African Explosives operates in an expanding field, supplying explosives and chemicals to the mining industry and fertilisers to the Union's farmers; paints, lacquers and synthetic resins also come within its scope.

In his statement to De Beers shareholders in May, 1955, Sir Ernest Oppenheimer pointed out that increasing dividends could be expected from the Industrial Corporation "as the various projects on the development of which African Explosives has spent so much during the last few years become fully productive".

GOLD AND URANIUM INTERESTS

The gold and uranium side of the business has been handled through De Beers Investment Trust, which was formed in 1952 to employ some of the Diamond Corporation's funds in furthering the development of the African Explosives undertaking, and in the opening up of the Far Western Rand and Orange Free State gold fields. De Beers holds directly only 13 per cent of the Investment Trust's capital. But 84 per cent thereof is held by the Diamond Corporation and the balance by the Consolidated Diamond Mines of South-West Africa. As already stated, De Beers has an 82 per cent stake in the Diamond Corporation, 59 per cent itself and 23 per cent through Consolidated Diamond Mines which is 97 per cent controlled by De Beers. The market value of De Beers Investment Trust's investments at December 31, 1954, exceeded their cost by over £6,700,000. At that date the Trust had also made loans "at satisfactory rates of interest" to other companies totalling just over £11,000,000. A considerable proportion of these loans carries "valuable conversion rights" into Ordinary shares of the companies concerned.

The Orange Free State gold producers of the Anglo American Corporation group naturally figure largely in the Investment Trust's portfolio. These mines are Free State Geduld, Loraine, President Brand, President Steyn, Welkom and Western Holdings. Three of them declared their maiden dividends in September, 1955. In common with the other new mines in which the Investment Trust is interested, these companies obviously represent a growing dividend potential. In 1954 De Beers Investment Trust made a profit after tax of just over £1,000,000, but because much of this was derived from share market operations it was decided not to pay a dividend but to use the profit further to strengthen the Trust's financial position. It was stated last year by Sir Ernest Oppenheimer that the value of the group's investments outside the diamond industry at December 31, 1955, totalled no less than £73,000,000.

These investments in industrial growth projects and in gold mining (the latter would actually benefit from any material setback in world trading conditions) obviously form a useful cushion against a falling away in diamond prosperity, but the future of De Beers is still, of course, largely governed by diamonds and therefore to a substantial extent by America, which is its largest customer. At the moment the picture in gem diamonds, which accounted by value for some two-thirds of last year's record sales, is a healthy one. There is no doubt that the producers could sell many more stones than are available even after the efforts that have been made to increase output notably at the De Beers group's South-West Africa property. The selling organization has been able to increase its prices twice. Both were advances of approximately 2½ per cent and took place in January and December, 1954. It is notable that price alterations occur so rarely.

There is also a good demand for industrial stones, which consist of low-grade material from the mines that has come into increasing demand during and since the war. It is not so very long ago when stones of this kind were regarded as waste products. Sales of industrials have been boosted in recent years by their inclusion in America's stockpiling programme. Now, however, the American authorities' stocks of these stones have reached the "minimum" targets set and whether there will now be any material additions thereto must be regarded as problematical. On this subject Sir Ernest Oppenheimer has said that when purchases from this source cease, the producers will be faced with over-production of these particular stones and it will thus, unlike the gem trade, be a question not of finding additional supplies but of seeking additional outlets.

INTERESTING OUTLOOK

What other possibly adverse factors are there? The General Electric group in America early in 1955 announced that a method had been perfected for the manufacture of synthetic diamonds since when good progress has been made and in May, 1956, man-made diamonds in limited quantities were reported to have been produced. However, much more work remains to be done before synthetic diamonds become commercially available at an economic price.

It is more difficult to assess the recent outbust of publicity from Russia concerning the alleged discovery of large diamond deposits in north-east Siberia. Soviet sources claim that the deposits may equal in importance those of South Africa and the intention is proclaimed to compete in the world diamond market. Whether or not this constitutes a threat to the world price structure so heavily influenced by the De Beers organization it is mpossible to say at this stage.

The De Beers dividend has now been static for five years at 200 per cent on the 5s. Deferred shares of which there is £4,082,684 in issue. The company also has £2,000,000 in 40 per cent Cumulative Preference shares of £2 10s. each. The Deferred dividend has been amply covered by consolidated earnings in recent times. Available earnings for this class of capital in 1954 were 365 per cent. In the five years during which the dividend has remained unchanged the price of the Deferred has fluctuated widely between under £3 to over £7. The present quotation is £5 5s. At this level the yield offered is 9.5 per cent. Many brokers consider this a more than adequate return for the shares of a group which has considerable growth prospects in one part of its economy, is still in a period of high prosperity in the other and has attained a position of exceptional financial strength.

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The Central Mining and Investment Corporation

THE celebration last year of the Golden Jubilee of The Central Mining & Investment Corporation Limited recalled fifty astonishing years of progress. However, by tradition, if not in fact, the Corporation's history extends even further back, beyond 1905 to the original pioneers who, with courage, patience and determination risked everything to establish the greatest goldfield on earth. Sir Julius Wernher, Mr. Alfred Beit and Sir Frederick Eckstein, now almost legendary figures in South African history, all played important parts in the development of the Witwatersrand after the discovery of gold there in 1886. The Central Mining & Investment Corporation was formed through these three men with the express object of strengthening public confidence in the Gold Mining share market and expanding the industry.

Since those early days, The Central Mining in London, and its partner, Rand Mines Ltd., in Johannesburg, has taken a leading part not only in the development of the Rand and Orange Free State goldfields, but also in the establishment and expansion of many other industries in South Africa. Outside the African continent, Central Mining's major interest is in oil through its association with Trinidad Leaseholds Ltd., which markets "Regent" petrol, one of the most popular brands in the United Kingdom. Recently that Company has extended its sphere of interests to Canada where it is raising and investing large capital sums in the future of that great Dominion. In Africa, Central Mining's main interests, apart from Gold, are in Coal mining, Forestry, Cement, Printing and Publishing, and Asbestos, while a glance at the map at the end of the Fiftieth Anniversary Brochure published in 1955 will show how widespread and diverse its activities continue to be.

"Activity" is an ideally descriptive word for The Central Mining & Investment Corporation. Field work of all kinds, including extensive geological surveys, and the collection and exploitation of all sorts of information are continually carried out by the expert and energetic Exploration Department in Johannesburg, and, with Uranium Oxide plants working to capacity at the Blyvooruitzicht and Harmony mines, the Group is already making a major contribution to the Atomic Age.

Between the "Corner House" (Central Mining & Rand Mines well known headquarters in Johannesburg) and London new enterprises are examined, created and encouraged; while the officials of the Corporation make frequent visits to Africa and other parts of the world in search of further opportunities for development.

The Central Mining & Investment Corporation, with Rand Mines, like the other contributors in this section of the Annual Review, is one of the Managing Groups which administer the Gold Mining industry in South Africa. A persistent and popular misconception exists in the minds of many who should know better that these Groups are merely powerful organizations monopolising the industry by their financial superiority at the expense of smaller independent mining businesses. Nothing could be less accurate than such a supposition.

The actual financial stake of the Groups in the individual mines is often large, but very seldom anything like a majority interest. In practice, the control a Group exercises is more by virtue of the confidence and support of the shareholders in its administrative ability than by the weight of its own holdings.

The formation of these groups was an administrative and financial necessity on the Rand; not only to ease the expense and difficulties of management, but also to promote public confidence in Gold Mining. By the issue of responsible progress reports, it was possible for the Groups to curb the wild speculation which so damaged the Industry's reputation during its early years.

The economy, efficiency and financial backing of centralized management by a group such as Central Mining / Rand Mines have not only enabled many mines to survive difficult periods, to the ultimate profit of the shareholders, the Group and the Industry, but have been instrumental in bringing others into production which otherwise might never have been exploited.

The staff of Central Mining / Rand Mines at the "Corner House," placed at the service of the various companies, includes Consulting Mining, Mechanical and Electrical Engineers, Geologists, Metallurgists, Chemists, and other expert and highly paid technicians which individual mines could not afford to employ. Other services provided by the parent Houses are secretarial, auditing and advertising; besides the centralized buying of equipment and essential stores. It is fair to say that the Gold Mining Groups give more detailed and frequent information to the investing public concerning their operations, results and possibilities, than any other industry.

The above brief description of the Group System as a whole is directly applicable to the working methods of the Central Mining & Investment Corporation, especially concerning its Gold Mining activities which remain its chief interest. In the following paragraphs some of the Corporation's Companies are described in detail, while the tables at the bottom of successive pages give the 1955 Development and Milling results for the thirteen gold mines administered by the Corporation.

BLYVOORUITZICHT GOLD MINING COMPANY

This first-class mine, which came into production early in 1942, has already distributed over £24,000,000 in dividends to shareholders. During the financial year ended June 30, 1955, the labour situation was still complex. The supply of non-European labour improved, but the continued shortage of European miners restricted the output, with the result that there was only a slight increase in the ore milled for the year. During the first months of the current financial year, the seasonal decline in the non-European labour strength has been more marked than for the same period of the year before. Nevertheless, the development footage accomplished was nearly 10,000 ft. up on the previous year. The average values of payable disclosures improved appreciably due to the greater amount of development in the richer Eastern area. In the far Western portion, where active prospecting is taking place, values continue to be lower than the average for the mine. The available ore reserve is practically unchanged.

During the past year, nearly 8 million gallons of water per day were pumped to the surface; however, the mine's pumping capacity is now 15 million gallons daily, thus giving a reasonable margin against an increase in the water encountered. The electric power position has improved and since September 1955 it has been possible to revert to a normal six-day milling week.

The uranium plant has operated satisfactorily during the year and the profits, before the deduction of loan repayment instalments of £470,000, amounted to £1,105,000. The total cost of the plant, and other buildings, houses, etc., now almost completed, will be £4,000,000. Since the end of the financial year, arrangements have been made with the Atomic Energy Board for the Company to build a pyrite-burning plant to produce sulphuric acid for use in the uranium industry. The cost will be approximately £750,000 and this sum will be provided by a loan from the Atomic Energy Board.

The working profit for the year for gold only was £5,564,000; £64,000 down on the previous year, the result of a slightly decreased yield combined with an overall increase in costs. However, the total uranium profit figure of £1,105,000, given above, brought the working profit for the mine to £6,669,000. Dividends amounting to a total of 2s. 3d. per share were paid.

CROWN MINES LTD.

In spite of the greater tonnage treated, working costs rose by 10d. per ton milled. However, this increase was practically entirely offset due to the gold production being nearly 27,000 oz. greater and to the added benefit derived from an improved gold price.

The footage developed increased mainly as a result of wider operations on Main Reef and on Kimberley Reef. Main Reef Leader development decreased substantially as payable prospects diminished.

There was a decrease of 35 per cent. in the payable ore developed and this, together with the higher pay limits set, were the main factors contributing to a decrease of 1,803,000 tons in the total ore reserve. The removal of shaft pillars was commenced during the year.

It is now established with little doubt that the South Rand dyke and the Vierfontein dyke each form part of the same intrusion.

DURBAN ROODEPOORT DEEP LIMITED

The downward trend in the working profits during the last few years was arrested and there was an improvement of nearly £41,000 as compared with 1954. This was due mainly to an increase in the tonnage milled and the mining of a slightly higher grade of ore, accompanied by an improved average price received per ounce of gold.

The Main Reef continues to be considerably faulted in the most westerly workings of the mine. Number 6A Shaft was sunk to its final depth and has been almost completely equipped.

Forty of the forty-eight additional dwelling houses, which were being erected to relieve the shortage of accommodation, have been completed and the remainder are partially completed.

EAST RAND PROPRIETARY MINES LIMITED

There was a modest increase in the tonnage of ore milled but working costs also rose to the extent of 1s. 9d. per ton milled. However, the higher yield coupled with an improved gold price enabled the working profit once again to exceed the £2,000,000 mark.

Work continued on the equipping of the Central Sub-Vertical Shaft as a hoisting shaft and South-East Sub-Vertical Shaft has also been equipped for hoisting men and material. The Ventilation Shaft which is being sunk to open up the Far Eastern section of the mine had reached a depth of 1,377 ft. at the end of the year. To provide additional ventilation in the lower levels of the Central section the Angelo West Vertical Shaft has been converted into a downcast Ventilation Shaft. The conversion of the Angelo Reduction Works to take power from the Electricity Supply Commission is virtually complete.

HARMONY GOLD MINING COMPANY LIMITED

The first stage of the exploitation of this mine was virtually completed by the beginning of 1955 and since then much progress has been made in operations under and above ground. Since June, after exhaustive investigations, it has been decided to sink a new shaft, No. 2, about 5,500 ft. north-west of No. 3 Shaft, in the immediate area of four boreholes which gave an average value of 1,350 in. dwt. This important decision has been taken to give the mine a second main hoisting shaft in a promising area and the total cost, including ancillary equipment and housing will be approximately £3,200,000. Underground operations have revealed that so far as at present exposed the reef body is not seriously disturbed by faults and dykes. Comparatively little water is being pumped to the surface and in view of the adequate ventilation facilities the Government Mining Engineer has relaxed considerably the "fiery mine" regulations.

The start of sinking operations at the new No. 2 Shaft at Harmony Gold Mining in November, 1955

An initial ore reserve of 931,000 tons, with a value of 8 dwt., was declared at June 30, 1955. The estimated reserve included only the ore lying immediately in advance of the stope faces or adjacent to the raises — on the basis of approximately one year's stope face advance.

In June 1955, the second 45,000 ton unit of the reduction plant was brought into production, giving a present capacity of 90,000 tons per month. However, during 1955, the non-European labour was insufficient to allow milling of more than just over 70,000 tons per month. In late 1955 to 1956, although the non-European labour supply became satisfactory, the lack of sufficient European miners has prevented increased production.

The 80,000 tons-per-month uranium plant was commissioned in April 1955, and is now working to capacity, using both current tailings and slimes accumulated in the dam. For the purposes of the Sale and Loan arrangements made through the South African Atomic Energy Board, the plant was certified capable of full production from July 1, 1955. Since the end of the financial year, arrangements have been made with the Board whereby the Company will erect a flotation plant to produce pyrites for use in the uranium industry. This will cost approximately £411,000 and will be financed by a loan from the Board repayable over nine years.

The Company's capital structure has been considerably simplified during the current year. As stated above, the issued (and authorised) capital is now £4,500,000 in 18,000,000 shares of 5s. each. This was achieved by the conversion into shares by December 31, 1955 of all save 12,467 of the 2,666,667 £1 Notes issued at par in November 1953; the subscription by Central Mining/Rand Mines for 450,000 reserve shares at 28s. 9d. each in December 1955, thus liquidating that Group's temporary loan; and the sale of the remaining 36,790 shares to Central Mining Free State Areas at the end of January this year. The remaining 12,467 Notes have been redeemed at par during the current year. Central Mining/Rand Mines have also undertaken to grant new temporary loan facilities of up to £250,000 at 6 per cent repayable by December 31, 1956.

COLLIERY INTERESTS

Witbank Colliery Limited. (Issued capital £385,000 in £1 shares)

The coal deposits owned by this Company are situated in the Transvaal and worked in two sections, Southern and Wolvekrans. The coal despatched from both sections during the year ended August 31, 1955, totalled 1,762,000 tons, an increase of 152,000 tons over the previous year. Transport shortages still hamper the distribution of coal, but in 1954/55, owing to a more extensive use of motor vehicles, the tonnage delivered was materially increased. Despite the close co-operation between the coal mining industry and the railways, the tonnages handled are still insufficient to satisfy demand.

Since the extensions and improvements, including a new washing plant, were completed at Wolvekrans, there was an increase of 162,800 tons despatched over the year from that section. Although the Southern section is adequately equipped to produce a considerably higher tonnage of crushed coal for the Witbank power station, orders totalled little more than the

FINANCIAL RESULTS *(for the last two complete financial years)*

COMPANY (*Year to Dec. 31 except where otherwise noted*)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS* £(000)								*Capital Expenditure*† £(000)		*DIVIDENDS PER SHARE*			
		Working Profit		*Uranium Profit*		*Taxation and/or Mining Lease*		*Net Profit After Tax**				*Paid*			
												1955		1954	
		1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	*June* s. d.	*Dec.* s. d.	*June* s. d.	*Dec.* s. d.
Blyvoor *a b*	24,000,000 (2/6)	5564·4	5596·2	633·2	531·7	3273·6	2946·4	2956·9	3238·7	268·3	461·1	1 1	1 0	1 2	1 2
City Deep	2,026,832 (£1)	23·4	175·4	—	—	1·9	7·4	110·5	217·7	143·8	115·0	—	—	6	6
Cons. M.R. *a*	1,247,602 (£1)	311·3	271·2	—	—	78·4	30·4	296·0	300·0	Cr 1.0	5·1	2 6	2 6	1 9	2 0
Crown	1,886,125 (10/-)	596·5	605·9	—	—	133·8	62·5	676·3	639·1	Cr 118.8	35·8	3 6	3 6	3 0	3 6
Durban	2,325,000 (10/-)	610·0	568·7	—	—	102 4	42·4	559·3	561·2	299·5	196·5	1 3	1 3	1 6	1 6
E.R.P.M.	3,960,000 (10/-)	2013·1	1521·7	—	—	694·3	397·2	1420·4	1179·0	540·1	552·3	1 9	2 0	1 9	1 9
Harmony *a b*	18,000,000 (5/-)	626·0	—	160·4	—	—	—	661·9	—	2019·6	3922 2	—	—	—	—
Modder B.	2,800,000 (1/6)	13·6	30·7	—	—	5·6	5·7	53·4	48·1	Cr 1.0	Cr 2.4	—	—	—	—
Modder East *a*	930,805 (£1)	177·8	156·4	—	—	55·9	32·4	146·1	150·3	—	—	1 6	1 3	1 6	1 6
New Modder *a*	2,800,000 (3/3)	7·4	11·2	—	—	2·3	2·0	11·5	14·8	—	Cr 2.4	—	—	—	—
Rose Deep	700,000 (14/-)	62·0	136·8	—	—	6·4	21·7	100·6	134·2	Cr 9.1	7·6	—	—	—	—
Transvaal G.M.E.	952,500 (£1)	6·8	10·8	—	—	—	—	26·7	38·6	Cr 2.0	24·6	6	3	6	6
Welgedacht *a*	1,358,030 (10/-)	13·9	29·1	—	—	—	—	9·2	24·2	Cr 0.5	—	—	—	—	—

* Includes sundry revenue less sundry expenses † Excludes Capital Expenditure on Uranium *a* Figures shown are for the years ended 30th June 1954 and 1955
b Uranium Producer

guaranteed minimum of 20,000 tons per month, and thus production fell by 11,000 tons to 253,700 tons during the year.

A most important event affecting all South African colliery interests took place in November 1955, when the Price Controller authorised appreciable increases in the price of all types of coal. This was the first adjustment since 1952 and considering the upward trend of costs, the rise in price was most welcome, as many profit margins had been reduced to a level incommensurate with the investment necessary to maintain production. The benefit of these increases is reflected in the latest interim dividend of 3s. per share.

Dividends totalling 4s. per share were declared during the year ended August 31, 1955; a rise of 6d. over the previous year.

Van Dyks Drift Colliery

Fortunately there was an increased, though irregular, supply of railway trucks during the financial year ended December 31, 1955, to this colliery near Witbank, which is owned and administered by Transvaal Consolidated Land and Exploration Company Limited. However, the output of coal has continued on an increased scale though the extent to which the demand for coal can be satisfied is mainly dependent on the success of the Railways Administration in surmounting its difficulties.

The tonnage despatched during the year ended December 31, 1955, was 707,000 tons compared with 616,000 tons for the year before and 558,000 tons for 1952. The profit earned was £165,000 compared with £130,000 for the previous financial year.

INDUSTRIAL INTERESTS

Pretoria Portland Cement Company Limited. (Issued Capital £1,456,250 in £1 shares)

During the financial year ended June 30, 1955, all four of this Company's cement factories operated at full capacity and the demand for its cement still exceeds production. The Company also has large interests in Cape Portland Cement, Eastern Province Cement (a wholly owned subsidiary) and the Premier Portland Cement Company (Rhodesia), which, in its turn, has extensive holdings in Northern Rhodesia Lime Co., and Chilanga Cement.

After provision for tax, the net profit amounted to £707,000 compared with £653,000 for the previous financial year. Dividends totalling 4s. per share were paid during the year compared with 3s. 6d. per share in the previous year. In December 1955, a dividend of 2s. 3d. per share and a bonus of 9d. per share were announced.

The Hume Pipe Company (South Africa) Limited. (Issued Capital £171,875 in 10s. shares)

This Company is mainly concerned with the manufacture of concrete piping, bricks, tiles and steel pipes, produced at six different factories in the Transvaal and Cape Province.

Demand and production during the year ended June 30, 1955, remained on the whole constant, registering satisfactory increases on the outputs of previous years. The profit for the year, after provision for taxation, amounted to £369,500, compared with £596,000 last year. These figures are, however, in no way comparable owing to the absorption in May, 1954, by the Company of Hume Steel, South Africa (Proprietary) Ltd. Thus, despite the contradictory figures, this reduction in profit does not represent any decrease in the Company's trading; in fact, as indicated above, business actually expanded. This apparent anomaly was due to higher depreciation applied to the Fixed Assets and to a lower profit margin accepted on certain large contracts.

During the year, £276,500 was expended on additions to and replacement of building plant, vehicles and field equipment. £150,000 was appropriated to Fixed Assets Replacement Reserve, bringing the total of that Reserve to £600,000. Distribution to shareholders during the year was raised 6d. to 10s. per share.

The Northern Lime Company Limited. (Issued Capital £1,650,000 in £1 shares)

Remarkable progress has been recorded since this Company, originally private, became public by an offer of sale made in December 1953. During the twelve months ended June 30, 1955, the production and sales of lime and limestone increased considerably with the result that the trading profit of £209,000 rose 25 per cent above that of the previous year.

The Company has two works; one near Taung in Northern Cape Province which opened in 1934/35, and the other at Silver Streams near Kimberley built in 1954. Originally this new plant was equipped with one rotary kiln — one of the largest in the world — capable of producing 300 tons of lime every 24 hours. Two similar kilns are under construction and should be completed in the very near future. Only when these three kilns are in full production will capacity approach demand.

The additional work at present in hand at Silver Streams will have cost about £900,000 on completion. In order to raise part of the money required, £330,000 6 per cent registered unsecured convertible notes were offered to shareholders in August 1955. The result of this offer was that 98 per cent of the notes were taken up by shareholders, the balance being taken up by the Underwriters, The Central Mining and Investment Corporation Limited.

OIL INTERESTS

Trinidad Leaseholds Limited. (Issued Capital £3,934,685 in 5s. units)

The West Indian and Canadian interests of this Company continued to expand vigorously during the year ended June 30, 1955, and since. A further rise in crude oil production in Trinidad was accompanied by an increase in the Group's proven reserves, and the volume of oil handled by the refinery on the island rose by 5 per cent. The production of premium gasolene — "REGENT T.T." and "REGENT BENZOLE MIXTURE" — for the United Kingdom was further increased to meet rising popular demands, despite fierce competition.

The Canadian subsidiary company, Regent Refining (Canada) Ltd. has concentrated on the development of its existing holdings under partnerships directed to that end. This Company, of which Trinidad Leaseholds Ltd. owns 90 per cent, has recently raised Canadian $13,000,000 to finance, among other things, the building of a major extension to the Port Credit refinery and to expand marketing facilities to meet growing output.

In December, 1955, a scrip issue on a "one for five" basis was announced by Trinidad Leaseholds Ltd. to bring the issued capital more into line with that employed in the business.

The consolidated net profit for the year ending June 30, 1955, was £2,313,000 — an increase of nearly £500,000 over 1954.

Dividends declared totalled 1s. 1d. per share free of tax. Of the combined total of £20,072,000 employed in the Group's business, £7,107,000 is represented by oil rights, buildings, plant and equipment (originally costing £21,477,000), £6,705,000 by investment in allied interests and £6,260,000 by net working capital.

DEVELOPMENT AND MILLING RESULTS *(for the last two complete financial years)*

COMPANY (Year to Dec. 31 except where otherwise noted)	TOTAL ORE RESERVES As at last report		DEVELOPMENT RESULTS						MILL THROUGHPUT													
			Ft. Sampled (000)		Payability %		Av. Value (In.-dwt.)		Tonnage				Gold Recovered						Working Profit			
									Tons Milled (000)		Cost per Ton		Ounces (000)		Mill Grade (dwt./ton)		Cost per ounce		Per ton		Per oz.	
	Tons (000)	Value (dwt)	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954
Blyvoor *a b*	6,852	12·1	17·8	14·0	90	89	712	536	1257	1193	55/9	51/9	722·8	698·4	11·5	11·7	97/-	88/5	88/6	93/10	154/-	160/3
City Deep	4,404	6·1	36·1	33·9	39	38	249	297	1936	1955	47/6	45/10	367·5	373·2	3·8	3·8	250/-	240/2	3d	1/10	1/3	9/5
Cons. M.R. *a*	3,609	4·0	24·1	19·5	37	37	252	367	2086	2022	33/2	32/5	300·6	285·8	2·9	2·8	230/1	229/6	3/-	2/8	20/8	19/4
Crown	10,297	4·9	50·9	39·8	35	54	297	315	3588	3460	36/11	36/1	575·0	548·3	3·2	3·2	230/7	227/6	3/4	3/6	20/9	22/1
Durban	8,982	4·1	37·4	41·8	42	58	380	410	2170	2139	36/11	36/-	367·4	354·1	3·4	3·3	218/2	217/9	5/8	5/4	33/2	32/5
E.R.P.M.	6,290	6·1	13·3	20·3	53	53	519	466	2540	2475	46/-	44/3	625·4	560·5	4·9	4·5	186/11	195/4	15/10	12/4	64/4	54/4
Harmony *a b*	1,057	7·8	7·5	8·5	77	97	497	635	495	—	62/9	—	173·7	—	7·0	—	178/11	—	25/4	—	72/1	—
Modder B.	50	3·0	—	—	—	—	—	—	672	677	25/-	25/3	67·8	70·7	2·0	2·1	248/2	242/1	5d	11d	4/-	8/8
Mooder East *a*	2,145	3·2	6·7	5·8	27	29	200	173	1490	1362	25/6	26/3	165·2	156·0	2·2	2·3	229/11	229/2	2/5	2/4	21/6	20/-
New Modder *a*	—	—	—	—	—	—	—	—	123	99	36/-	37/10	18·2	15·9	3·0	3·2	242/11	234/7	1/2	2/3	8/2	14/4
Rose Deep	584	4·3	11·9	16·6	25	29	393	357	668	839	37/8	34/10	104·9	128·1	3·1	3·1	239/9	228/4	1/10	3/3	11/10	21/2
T'vaal G.M.E.	51	8·2	7.0	3·8	44	35	236	245	278	294	58/8	57/6	60·8	64·2	4·4	4·4	268/5	263/2	6d	9d	2/3	3/5
Welgedacht *a*	281	2·5	5·2	4·4	29	29	143	130	399	397	28/7	29/3	46·3	48·8	2·3	2·5	245/10	237/10	8d	1/5	6/-	11/11

* Includes sundry revenue less sundry expenses † Excludes Capital Expenditure on Uranium. *a* Figures shown are for the years ended 30th June 1954 and 1955
b Uranium Producer

Union Corporation Ltd.

THE inclusion of United Kingdom taxation in the accounts of Union Corporation, which is incorporated in the Union of South Africa, causes, on occasions, some perplexity. The amount involved is not small : in 1955, U.K. income tax took £448,653 and profits tax a further £18,400. The reason for this apparent anomaly is that the U.K. tax authorities judge the corporation to have a British domicile.

This big and influential mining finance house has played a large part in the development of the Eastern Rand. It pioneered gold production in the Orange Free State with St. Helena and it is now sponsoring the first mine, entitled Winkelhaak Mines, to exploit a property in the Bethal area, about 70 miles, east-south-east of Johannesburg. The exploration necessary before Winkelhaak could be floated, as well as the investigation of adjacent property, has laid a heavy burden on the parent company. In 1953, the board appropriated £600,000 of the year's profits for the exploration reserve account and £275,000 in 1954, Although the strain was lessened in 1955, it still required the allocation of £50,000.

Revenue in 1955 continued to come predominantly from dividends and interest, no less than £1,660,861 out of a total income of £2,207,789 having been derived from this source. Sharedealing profits brought in a net £398,289 after deduction of an unspecified amount applied in reduction of book values. After providing for administration expenses, net revenue from fees, interest and sundry receipts, contributed the remaining £148,639.

An analysis of the Consolidated balance sheet at the end of 1955 shows a less clearly marked line of predominance. Taking book values alone, investments, accounted for only just about one-third of the total assets of £21,994,678. There is however a large favourable discrepancy between the book values of investments which include unquoted stock and debenture holdings at or under cost of £291,987, totalling £7,073,928 and their market shares amounting to £19,493,309. The other main item in the balance sheet are debtors and cash assets, totalling £13,007,721 of which the most important constituents are £2,394,845 cash in hand and at bankers ; £4,784,057 in British and South African Government securities ; and £4,475,000 in money at call. Against this large quantity of liquid assets stand current liabilities and provisions of £10,524,008.

Even so, these liabilities and provisions, plus the £901,457 loan capital of the subsidiaries, and the £884,799 interest of outside shareholders in the subsidiaries could be extinguished by debtors and cash assets, leaving about £700,000 of liquid assets and the quoted investments valued in the market at £19,493,309 as backing for the issued capital of £1,075,094. In addition there would be the fixed assets, carried in the books at £1,712,609, but there also exists contingent liabilities of £272,450.

The custom of declaring dividends " tax free ", having caused confusion in the calculation of yields, has been abandoned, and dividends are now declared subject to tax deduction at the standard rate. Incidentally, this method enables the company to pass on to the shareholder the benefit of reductions in the standard rate of tax. The dividends paid for 1954 were equal to 2s. 8.909d. per share less tax, the interim having been declared on the old " tax-free " basis, and the final on the new. The total of 2s. 9d. per share declared for 1955, was composed of an interim of 1s. and a final of 1s. 9d. both less tax. Profits for 1955, amounted to £1,119,689 against £1,081,279.

The corporation's assets fall into five main classes : first debtors and cash assets, which have already been considered ; second, are the Rand mining companies which produce an important part of the Corporation's profits ; third, the interests in the O.F.S. ; fourth, the new Winkelhaak Mine in the Bethal area ; and fifth, the investments in other mining concerns and industrial companies.

RAND PRODUCERS

The Union Corporation group on the Rand comprises six companies, all possessing property in the Eastern part of the goldfield. One of these six, Withok Proprietary, owns a large area of land but does not operate. The remaining five are actively winning gold ; alphabetically they are : East Geduld Mines, Geduld Proprietary, Grootvlei Proprietary, Marievale Consolidated and Van Dyk Consolidated.

East Geduld provides the group's biggest profits from the Rand by virtue of its moderately large plant — it treated 1,765,000 tons in 1955 — and of having the highest grade — 6.18 dwts. per ton in 1955 — of the group. Its gross profits of £4,119,915 suffered tax at the average rate of a little over 55 per cent, leaving net profits of £1,915,873. Almost the whole of this was distributed to shareholders, the amount per stock unit having been raised once again, from 3s. 9d. to 4s. 3d.

At the increased milling rate of 1,765,000 tons a year, the ore reserves at the end of 1955 were equal to six years' supply to the mill.

GEDULD AND GROOTVLEI

Although Geduld Proprietary still mines on a fairly extensive scale — it treated 1,233,000 tons during 1955, recovering 199,186 oz. of gold — its most important source of profits is income from its investments. Working profits from gold brought in £505,740, but after tax had taken £213,961, and sundry items had been allowed, net profits from mining came to only £328,626, whereas income from trade investments realized £747,907, and this is not taxable in the hands of a South African recipient.

Chief of these investments is the holding of 3,308,425 stock units in East Geduld, roughly 36 per cent. of the capital of that company. Dividends from this source provided 94 per cent. of the dividend income mentioned above ; almost the whole of the remainder came from the holding of 358,400 units in Grootvlei Proprietary.

By reducing the working costs per ton, Geduld increased profits per ton from 6s. 11d. to 8s. 2d. This satisfactory result was, however, marred by the sharp drop in the tonnage of the ore reserves. At 1,500,000 tons, they are equal to little more than a year's supply to the mill. This is perhaps an unneccessarily gloomy comparison, since development has been ignored ; nevertheless, the decline in the ore reserves was equal to 40 per cent. of the year's mill treatment. Once again stockholders have enjoyed a larger distribution, a total of 14s. 9d. per stock unit against 12s. 3d. for 1954.

Grootvlei's treatment plant is amongst the largest on the Rand : it treated 2,322,000 tons in 1955 yielding 503,450 oz. of gold. Working profits for that year improved from £2,632,721 to £2,965,482 partly because revenue rose from the increased yield of 4.34 dwt. per ton, and the average price of gold was slightly better, and partly because working costs per ton were lower. The expansion led to net profits of £1,411,888 as compared with £1,274,287, and shareholders who had suffered a cut in the 1954 dividend to 2s. 1d. per share received an increase to 2s. 5d.

Ore reserves at the end of 1955 contracted by 500,000 tons to 15,500,000 tons.

FINANCIAL RESULTS

(for the last two complete financial years)

COMPANY (*Year to Dec. 31*)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS* £(000)								*Capital Expenditure* £(000)		*DIVIDENDS PER SHARE*			
		Working Profit		*Uranium Profit*		*Taxation and/or Mining Lease*		*Net Profit After Tax*				*Declared*			
												1955		1954	
		1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	*s. d.*	*s. d.*	*s. d.*	*s. d.*
East Geduld.....	9,000,000 (4/-)	4091·9	3769·8	—	—	2270·6	2065·9	1915·9	1771·5	16·5	26·5	2 3	2 0	2 0	1 9
Geduld Prop.	1,460,857 (£1)	505·7	386·4	—	—	214·0	128·7	1077·4	935·2	1·6	1·6	8 0	6 9	6 9	5 6
Grootvlei	11,438,816 (5/-)	2965·5	2632·7	—	—	1574·4	1372·3	1411·8	1274·3	—	42·5	1 4	1 1	1 1	1 0
Marievale	4,500,000 (10/-)	1071·5	930·2	—	—	524·1	436·2	547·6	487·1	38·4	13·8	1 3	1 0	1 1	11
St. Helena	9,625,000 (10/-)	1640·3	759·9	—	—	—	—	1585·0	686·9	1489·4	103·2	—	—	—	—
Van Dyk	5,532,000 (10/-)	36·3	20·2	—	—	—	—	40·1	22·4	—	16·8	—	—	—	—

MARIEVALE

The ore position at Marievale on the extreme eastern end of the East Rand continues to develop satisfactorily. At the end of last December, the estimated tonnage had grown to 4,500,000 tons, an increase of 500,000 tons during the year. Since the mill treated 857,000 tons — an expansion of 57,000 tons in the year — the ore reserves were equal to over five years' supply. This is encouraging but probably even more significant than this comparison was the fact that the reserves were growing rapidly enough to raise the number of years supply to the mill; at the end of 1954 they were equal to exactly five years' supply. The company raised its 1955 net profits, after the tax authorities had taken an extra £90,000 or so, from £487,148 to £547,625. This was largely because revenue added approximately another £250,000, following an improvement in the grade from 5.10 dwt. per ton to 5.19 and the bigger tonnage already mentioned, and because working costs increased by roughly only £106,000. The need to spend only a net £38,389 on fixed assets enabled the board to raise the dividend once again, this time from 2s. per share to 2s. 3d.

VAN DYK CONSOLIDATED MINES

Van Dyk's huge area, covering 7,646 claims, is the most westerly of the Group's Rand mines. Until three years ago the grade at this mine had been dropping, reaching the comparatively low level of 2.95 dwt. per ton in 1952, from a tonnage of 1,246,000 tons. Since then the tonnage has been smaller — it was 962,000 tons in 1955 — but the grade rose to around the 3.3 dwt. mark. In this way the company has been able to withstand the constant pressure of rising costs. In 1955, it cut working expenditure per ton from 42s. 5d. to 40s. 5d., but owing to a lowering of the grade, revenue fell from 42s. 10d. to 41s. 2d. An increase of 4d. per ton in profits might seem to be small, but it made a large difference to the marginal profits of this mine, working profits rising from £20,179 to £36,300. Sundry revenue produced the important amount of £14,420 and net profits realized £40,102 (£22,653), but this was ploughed back into the business.

The non-operating company, Withok Proprietary, owns 4,828 morgen to the south east of Van Dyk ; boreholes have been sunk on the property.

ORANGE FREE STATE INTERESTS

Union Corporation has interests in three other South African mining concerns. It holds shares in Stilfontein Gold Mining, whose activities in the Klerksdorp area are described on page 263 ; in Western Holdings, the O.F.S. producer, reviewed under the Anglo American Corporation group on page 249 ; and in another O.F.S. mine, St. Helena, to which the Corporation acts as secretaries and consulting engineers.

ST. HELENA

The improvement in this mine since it first started commercial operations in November, 1951, has been remarkable. Faced with the technical difficulties which confront any pioneering venture, it was one of the first two O.F.S. mines to start gold production — and handicapped by lack of geological information, which has now become more freely available as a result of extensive underground development in this mine and elsewhere, St. Helena sunk its first shafts into fairly low-grade ground. Quickly, however, it turned the early losses into profits until in 1955, it made a net profit of £1,585,052. This was accomplished by increasing the throughput from 598,000 tons in the first full year, to 1,238,000 tons in 1955, and raising the grade from 3.96 dwt. per ton in the first full year, to 5.34 dwt. in the latest complete year. The two movements had the effect of expanding revenue from 50s. 8d. per ton milled to 67s. 2d., and of reducing cost per ton from 46s. 6d. to 40s. 8d. Working profits under the stimuli of these two favourable actions have grown from 4s. 2d. to 26s. 6d. During the first quarter of the current year, the grade improved still further, to 5.87 dwt. and though the throughput was reduced, working profits per ton advanced to 31s. 5d.

Contemporaneously, the ore reserves have been steadily built up, reaching an estimated 3,000,000 tons at the end of 1955, with an assay value of 6.0 dwt. over an estimated stoping width of 55 in. So far the capacity of the mill has been rated at a nominal 100,000 tons per month, but extensions now completed, will increase capacity to 125,000 tons per month, and later extensions will bring it up to 150,000 tons.

To help the general development of the mine, a No. 2 shaft is being sunk about half a mile away from the present line of working towards the President Brand border. At the end of last March, the shaft had been sunk to a depth of 1,591 ft. ; a borehole drilled immediately adjacent to the shaft intersected the Basal Reef at a depth of 4,071 ft. The borehole results were disappointing, though too much importance should not be attached to the result since the borehole was sunk to seal off by cementation any water-bearing fissure which might delay shaft sinking.

Although profits in 1955 had been encouraging, the capital expenditure on the plant extensions and the new shaft had been heavy, and it was not until March, 1956, that St. Helena paid its maiden dividend of 6d. per share.

WINKELHAAK MINES

Once again Union Corporation has blazed a pioneer trail, with the formation of Winkelhaak Mines, to exploit a mining lease of 5,115 claims, roughly 30 miles to the east-south-east of the eastern edge of the Rand. The company issued its prospectus last January.

It is believed that gold should be produced in two and a half years — though some commentators think that because the first two shafts will be sunk to the comparatively shallow depth of 1,500 ft., an earlier start is possible. After three and a half years a milling rate of 60,000 tons per month is envisaged, and at the end of a further two years, after a third shaft has been sunk to a depth of 3,750 ft., milling can be expanded to 100,000 tons per month. Total cost of the programme is put at approximately £10,500,000, and a total of 12,000,000 10s. shares have been subscribed at par by Union Corporation or its wholly owned subsidiary, Capital Mining Areas. Part of the remaining £4,500,000 will come out of profits from operations in the early years and the balance raised by such means as may be found most suitable in the circumstances.

Outside the Winkelhaak Company's Lease Area some encouraging results have been obtained by Capital Mining Areas and by Acacia Mines Ltd., one of the Corporation's subsidiary exploration companies, operating adjacent to Capital Mining Areas. And if these present indications are confirmed by further drilling it is possible that, in due course, two further mines may be proved on ground which these companies control. However, a good deal of drilling is still needed before a proper assessment of the position can be made. In the light of extensive drilling carried out by the Corporation's other subsidiary exploratory company in the Kinross area, options over large areas are being abandoned.

OTHER INVESTMENTS

Outside gold mining, Union Corporation has interests in the Rhodesian Copperbelt, through a holding of Selection Trust which, incidentally, also has important interests in the Orange Free State. It also holds shares in San Francisco Mines of Mexico, producer of large quantities of lead, zinc and silver. The Corporation's base metal investments include Chrome Mines of South Africa and Tsumeb Corporation.

The Corporation has entered the field of industry, partly by holding shares in Bay Hall Trust, which in turn owns investments in industrial companies, and partly by direct interests in British Enka, the well-known producer of rayon, and in South African Pulp and Paper, which has paper mills near Johannesburg and in Natal.

DEVELOPMENT AND MILLING RESULTS

(for the last two complete financial years)

COMPANY (Year to Dec. 31)	TOTAL ORE RESERVES As at last report		DEVELOPMENT RESULTS						MILL THROUGHPUT													
			Ft. Sampled (000)		Payability				Tonnage				Gold Recovered						Working Profit			
					%		Av. Value (In.-dwt.)		Tons Milled (000)		Cost per Ton		Ounces (000)		Mill Grade (dwt./ton)		Cost per ounce		Per ton		Per oz.	
	Tons (000)	Value (dwt)	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954	1955	1954
East Geduld	11,700	5·8	7·8	6·5	69	66	404	413	1765	1663	31/4	31/5	545·4	511·4	6·2	6·1	101/3	102/1	46/4	45/4	150/-	147/5
Geduld Prop.	1,500	3·6	11·0	10·8	35	13	265	237	1233	1122	32/6	33/11	199·2	183·3	3·2	3·3	201/-	207/9	8/2	6/11	50/9	42/2
Grootvlei	15,500	4·6	17·6	19·5	48	41	213	194	2322	2185	28/11	29/2	503·4	467·0	4·3	4·3	133/4	136/8	25/7	24/1	117/10	112/9
Marievale	4,500	5·4	28·5	24·0	46	40	242	268	857	800	40/2	40/4	222·2	203·9	5·2	5·1	154/11	158/4	25/-	23/3	96/5	91/3
St. Helena	3,000	6·0	18·7	21·5	54	61	382	401	1238	1041	40/8	41/10	330·7	235·4	5·3	4·5	152/1	185/1	40/8	14/7	99/2	64/5
Van Dyk	800	3·8	18·8	21·5	25	27	286	229	962	940	40/5	42/5	157·6	161·4	3·3	3·4	246/8	246/11	9d	5d	4/7	2/6

Anglo-Transvaal Consolidated Investment Co. Ltd.

THE main spring of South Africa's economy is gold, but gold mining and secondary industry today in South Africa, are inter-dependent, and to an extent, not perhaps fully realized outside South Africa itself. Nevertheless, it is rare to find a leading gold mining group with wide industrial interests. The Anglovaal group of companies of which Anglo-Transvaal Consolidated Investment Company, Limited is the parent Company, is an exception. For this reason, Anglovaal today is much more than a simple investment undertaking, for its substantial investments, though basically centred on gold, range over a wide field in mining and in secondary industry.

In relation to the size and extent of the group's interests, the capital structure of Anglo-Transvaal Consolidated Investment Company, Limited, is still relatively small and the proportion occupied by the equity is, by the same standard, low indeed. The issued capital of Anglo-Transvaal Consolidated Investment Company, Limited amounts to £2,775,420, which is made up as to £550,000 in 6% £1 Cumulative Preference Shares, £1,000,000 in 5% Cumulative Redeemable Second Preference Shares of £1 each, 462,920 £1 Participating Preference Shares and equal amounts totalling £762,500 in 3,150,000 5s. Ordinary and "A" Ordinary Shares. Revenue reserves stand at £3,879,124.

The Balance Sheet for the year ended 30th June, 1955, showed a net profit of £882,154 as against £844,632 for the previous year. The profit was derived principally from Fees, Interest, Commissions and Dividends. Less than 20% of this net profit is shown on the Balance Sheet as coming from "Profit on realization of investments."

In recent years the mining activity of the group has been directed towards opening up new mines in the Orange Free State and in the Klerksdorp areas. The group now controls two producing gold mines in the Orange Free State, Virginia and Merriespruit.

The Virginia mine commenced production in September, 1954, with a first monthly working profit of just over £5,000. In March, 1956, the monthly profit from gold had increased to £23,518. Virginia's profits, however, have bounded ahead sharply since Uranium and Acid production started at the end of 1955. The combined monthly profit from all three sources of activity, Gold, Acid and Uranium, amounted to £135,488 for March, 1956. For the Quarter ended 31st March, 1956, Virginia milled 231,000 tons to recover 50,487 fine ounces of gold. Values and payability at Virginia have also improved with increased development north west of No. 1 shaft area of the property. According to the March, 1956, figures, percentage payability was 64.1% with an in.-dwt. value of 404. The present issued capital of Virginia amounts to £3,319,738 in 5s. Units of Stock. At the time of the last Balance Sheet there were Debentures and Fixed Loans, including those for Uranium, outstanding to the extent of £13,206,504 and there were options to Loan Stockholders in respect of 2,114,286 Shares at 17/6d. per Share, and an additional 634,286 Shares in satisfaction of the right to subscribe in cash for three additional Units of Stock at 10s. each, for every 10 Ordinary Stock Units acquired on conversion.

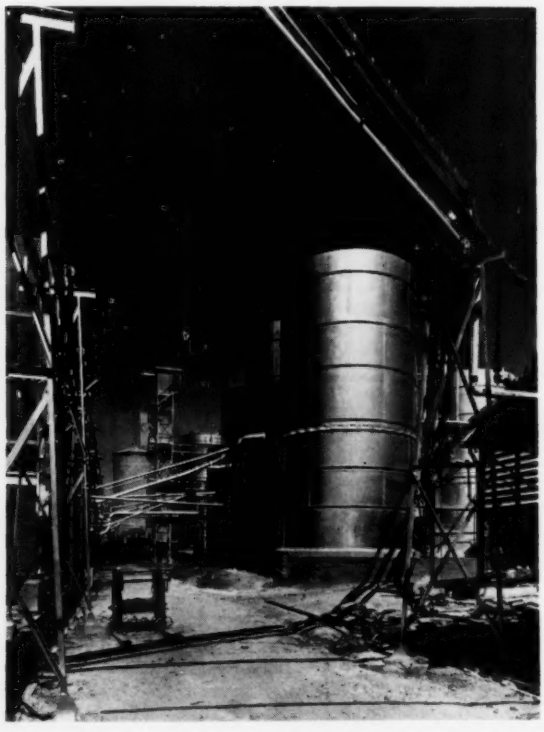
The Virginia Sulphuric Acid Plant is the largest unit of its type in the Southern Hemisphere. Its output is supplied to all the Uranium Leach Plants in the Orange Free State.

MERRIES AND HARTIES ESTABLISH RECORDS

The Merriespruit gold mine made a maiden declaration for March, 1956 with the profit from the gold, at £45,433, and with a profit of £4,615 from Uranium. The Merriespruit Mine, although accepted as a producer of Uranium, delivers a concentrated product to the Virginia Plant and receives a pro rata share of profits, derived from that source. The milling rate at Merriespruit is 75,000 tons of ore per month, which is the highest initial tonnage ever achieved by a Free State gold mine in its first month of production.

Merriespruit's issued Share Capital totals £2,559,869 in 5s. Units of Stock. At the time of the last Balance Sheet, the total loans, including Uranium loans, amounted to £6,899,247. The holders of the £5,000,000 loan stock have the right to convert 40% of such loan stock into shares at 12/6d. per share until 31st December, 1958.

Perhaps Anglovaal's most successful mining venture in recent years, has been the Hartebeestfontein gold mine. Work started here in January, 1953 and, within 2½ years, Hartebeestfontein entered the lists of producing gold mines, with an initial record profit of £57,700. What was even more remarkable, was that the mine reached the stage of production on the low capital expenditure, in relation to the planned mill capacity, of £8,850,000. Of this total the equity consists of £4,500,000 in 9,000,000 10s. shares. Hartebeestfontein's



The pachuca storage tanks at the uranium plant of Virginia Orange Free State Gold Mining

No. 1 shaft headgear at Merriespruit G.M., showing the ore conveyor belt from the shaft to the mill

scheduled mill capacity was 50,000 tons of ore per month. In its first month of production the mill tonnage reached was 44,000 tons and it has climbed steadily until now the mine is milling 57,000 tons or ore per month. The milling rate is now being increased and will shortly reach the level of 65,000 tons of ore per month, and thereafter, progressively to 100,000 tons of ore per month, at which capacity, the mine is scheduled to become a Uranium producer with a contract starting in the early part of 1957. The profit for the Quarter ended 31st March, 1956, amounted to £420,380.

Hartebeestfontein's quick success is to a certain extent a consequence of the comparatively favourable mining conditions encountered, notably in grade and in payability, which latter has averaged between 90% and 100%. Credit must also be paid to the the management which has kept expenditure to a minimum and which has made successful innovations in isolated techniques.

THE VALUE OF UNDERGROUND SORTING

The sorting of waste underground, at Hartebeestfontein for example, has developed into an art of its own and mining down to as narrow as a 30-in. stope has also been achieved on occasion. On surface, the mine employs mechanical methods of sorting and again, utilizes reef picking, all of which have played an important part in keeping mill grade up to a high level. It is significant that although the cost per ton milled at Hartebeestfontein has shown an increase and is now levelling off around 66s. per ton, the cost per ounce produced has shown a steady reduction to a figure of 139s. 2d.

Most of the Anglovaal group's exploratory work has been undertaken through Middle Witwatersrand (Western Areas) Limited, which Company exists to handle the early stages of mine exploration and development and later to float off new mining undertakings as a major vendor Company with favourable participation terms for Shareholders. Two further new mining Companies, both sponsored by Middle Witwatersrand are to come under the technical management of Anglo-Transvaal Consolidated Investment Company, Limited in the near future. One is the Zandpan Gold Mining Company Limited whose property is to the west of Hartebeestfontein and the other is the Riebeeck Gold Mining Company Limited, which has been formed to exploit the van den Heeversrust area, north-west of Odendaalsrust. It is on this ground that drilling has indicated very high values in a series of multiple reefs occuring in the Elsburg series. From borehole results the behaviour and correlation of these reefs would seem to call for special mining methods and the new Company, therefore, when work is started

Drilling in a reef drive on Merriespruit

will be faced with a proposition unique in O.F.S. experience.

On the base metal side Anglovaal controls Associated Manganese, South Africa's largest producer of Manganese Ore, and Consolidated Murchison, which is now the largest producer of antimony in the Western World. Anglo Transvaal Collieries Ltd. looks after the coal production side of the group.

The group also controls Anglo-Alpha Cement and Union Lime Company which together represent one of the largest lime quarrying and cement making undertakings in South Africa.

It should also be recorded that Anglovaal controls the South Atlantic Corporation Limited, which is itself the holding Company for the largest fishing undertaking in Southern Africa, both in the distribution of fresh fish and of frozen fish and in the recovery of fish by-products. Anglovaal also administers Consolidated Glass Works Limited.

The cylindrical concrete headgear of the main hoisting shaft at the Hartebeestfontein gold mine in the Klerksdorp area, showing the conveyor for the transportation of ore from the headgear to the stockpile.

General Mining and Finance Corporation Ltd.

DURING the year 1955, General Mining and Finance has apparently been consolidating its position after its extensions in the two preceding years. At the end of 1952, the balance sheet total for the parent company was £7,719,901 ; a year later it was up to £9,712,116 and by the end of 1954, to £17,083,291. Had it been possible to make a three-year comparison using the consolidated balance sheets, the progress made would have been much more impressive, for between end of 1953 and end of 1954, the total of the consolidated balance sheet rose from £10,747,084 to £19,637,429. These calculations have been based on the book values, but if the market value of quoted investments is adopted fro the consolidated balance sheet, the expansion during 1954 was even greater, the total value of the assets rising from £14,818,345 to £27,406,742.

From the shareholders' point of view, an increase in the value of the assets is of rather less interest than a growth in income, and this too, has been achieved. Again, owing to the absence of consolidated accounts for the years prior to 1953, a comparison of consolidated income is possible only for 1953 and 1954. Here, income grew from £1,105,705 in 1953 to £1,650,631 in 1954. Expenditure, especially on tax, has expanded, but only from £172,374 to £275,823, and net profits have risen from £933,331 to £1,374,808. So far as can be seen from the preliminary profits statement, the consolidated profits for 1955 are likely to be lower than those of the previous year. But preliminary figures suggest that there is a favourable aspect, which is discussed later.

Much of the reason for the 1953 expansion was the acquisition of the shares of Consolidated Rand Investment and of Transvaal Mining and Finance in exchange for shares in General Mining, thereby becoming wholly owned subsidiaries.

The far greater expansion in 1954 resulted partly from the merger of the Strathmore group with General Mining ; again the method adopted was an exchange of shares, on this occasion one Ordinary share of General Mining being offered for every two Strathmore shares held. For a time the General Mining shares issued in exchange for the Strathmore shares were specially designated "S" Ordinary shares, since they were not entitled to any dividend declared in respect of the financial year ended December 31, 1954. This special designation has been abolished since June 1, 1955. An issue of "S" Ordinary shares was made in 1954 to nominees of the Anglo American Corporation for a consideration of £822,500 payable in cash, and this amount was used to acquire a portfolio of securities from Anglo American Corporation at the then current market prices.

As a result of these transactions, the capital of General Mining has grown from £2,427,286 at December 31, 1952, to £3,624,321 by the end of 1954. The capital of this Corporation is rather more complex than usual, part being in the form of 6 per cent. cumulative convertible redeemable "A" Preference shares, convertible at varying prices until September, 1959, after which date all unconverted shares will be redeemed by the Corporation, not later than September 30, 1969. By the end of 1954, holders of 258,499 Preference shares had exercised their options, mostly at 90s., preferring to take the Ordinary shares which, having paid 25 per cent. since 1936, virtually offer the security of a cumulative Preference share. This choice has involved them so far in a loss of income, but they have acquired the possibility of a larger return eventually. Now that the option stands at the equivalent of £5 per Ordinary share, offering a yield of only 5 per cent., as compared with the 6 per cent. from the Preference shares, conversions are less likely, at least until nearer the time when the price increases to 110s.

To return to the question of 1955 profits, earnings of the parent company alone were £906,492 against £1,147,382, and the drop was entirely due to sharedealing profits falling sharply from £451,684 to £13,463. It follows that if one part of the profits contracts by £438,221 and the total is reduced by only £240,890, the remaining part must have expanded by almost £200,000. This means that General Mining's revenue and profits from dividends and sundry revenue are growing and as income from this source is usually more stable than that from sharedealing, the change ought to be welcomed.

General Mining's investment portfolio is extensive both in the number of securities it contains and in the type of economic activity covered.

The more important companies, other than subsidiaries, administered directly or indirectly by the Corporation are as follows : Alpha Free State ; Babrosco Mines ; Blinkpoort Gold ; Buffelsfontein Gold ; Doornkop Sugar ; Eastern Rand Extensions ; Ellaton Gold ; General Exploration O.F.S. ; Glenara Estate and Mining ; Kenilworth Estates ; Lydenburg Platinum ; New Pioneer Central Rand Gold ; S.A. Silica Bricks ; South Roodepoort Main ; Southern Van Ryn Reef Gold ; Stilfontein Gold ; West Rand Consolidated ; Transvaal-Orangia Exploration ; Vanriebeeckstad Development ; Van Ryn Gold ; and Western Transvaal Regional Water.

In addition, the Corporation has major quoted investments in African and European Investment ; Bancroft Mines ; Blyvooruitzicht ; Crown Mines ; De Beers Consolidated ; Doornfontein Gold ; Durban Deep ; East Rand Proprietary ; Free State Geduld ; Harmony Gold ; Masonite ; Metal Traders ; President Brand ; President Steyn ; Rand Mines ; Rand Selection ; Scaw Metals ; S.A. Pulp and Paper ; Venterspost Gold ; Vereeniging Estates ; Virginia O.F.S. ; Vogelstruisbult ; West Driefontein ; West Witwatersrand Areas ; and Western Holdings.

The best classification of the group's main interests for more detailed consideration is first, the uranium interests ; secondly, Ellaton Gold and South Roodepoort, then, Buffelsfontein, expected to come to production towards the end of 1956, and finally, General Exploration O.F.S. and New Pioneer Central.

WEST RAND CONSOLIDATED MINES

Owing to the secrecy which still surrounds many aspects of uranium production despite protests against its rather indiscriminate continuation, it is not possible to assess West Rand Consolidated's importance as a producer of uranium. It is, possible, however, to visualize the significance of the mine to the General Mining group. Working profit from uranium amounted to £3,207,970 before taking into account interest and loan repayments and reflects an increase of £953,046 over the results obtained for the previous year. As the amount of loan interest and repayment has been fixed in order to amortise it by the end of 1963, the expansion in profits mentioned above is not affected. There are, nevertheless, other factors which must be considered.

Year to Dec. 31	*Gold*	*Other Minerals*	*Mining Costs*	*Uranium**	*Dividend*	*Tax*
	£	£	£	£	%	£
1955	3,995,410	104,320	4,640,969	3,207,970	37½	992,020
1954	4,422,617	57,780	4,462,169	2,254,924	37½	756,315
1953†	4,587,948	61,269	4,225,832	1,367,998	37½	467,666
1952	5,102,195	76,069	3,614,178	124,707	30	351,190

* Subject to adjustment. † Calculated on new basis.

Although the total amount of ore sent to the mill during the year rose from 2,750,000 tons to 2,804,000 tons, the amount sent to the mill simply for the gold content dropped from 2,086,000 tons to 1,964,000 tons. This means that the amount sent to the mill for its gold and uranium content jumped up from 664,000 tons to 840,000 tons. The amount of gold recovered from the gold/uranium ore is very small : in the March, 1956 quarter it averaged only 0.84 dwt. per ton, whereas the recovery from the gold ore was 2.60 dwt. The switching over from the one type of ore to the other depressed the total amount of gold recovered from 355,423 oz., to 318,566 oz., and though the average price received for gold during the year improved from 248s. 10d., to 250s. 8d., revenue from gold contracted from £4,422,617 to £3,993,410. This loss of revenue was largely if not entirely caused by the desire to obtain more uranium, and hence it ought to be set to some extent against the increase in uranium profits mentioned earlier.

Another expense falls to be charged against that increase. Working expenditure rose from £4,462,169 to £4,640,969, and it seems probable that this heavier expenditure came from treating the bigger tonnage of ore and preparing it for despatch to the uranium extraction plant. Allowing for these factors, and for minor revenue and expenditure items, gross profit for 1955 amounted to £2,474,335 against £2,143,691, interest and loan repayments having been deducted in arriving at this gross profit.

Then comes the tax charge : £992,020 as compared with £756,315, reducing the net profit to £1,482,315 against £1,387,376. In this way the highly satisfactory increase of £953,046 in uranium profits alone is whittled down to around £95,000.

The construction of the uranium plant is being financed in what has now become the traditional manner of loans ; at the end of 1955 the sum of £2,035,439 was owing and this, as stated

earlier, will be amortized together with interest payments by the end of 1963. Not all the amount borrowed had been used at December 31, 1955, some £40,592 remaining unspent. All the major units of the plant have been completed but in order to facilitate the efficient running of the plant it is necessary from time to time to instal additional items of plant and equipment of a comparatively minor nature. Whilst these items could be financed from extra uranium loans, the more probable course will be to draw on future profits, after the unspent £40,592 has been used up.

Increases in recent years in the net profits of the company have not been accompanied by larger dividends, the last increase was for 1953,when 37½ per cent was paid instead of the previous 30 per cent. After payment of the 1955 dividend on the ordinary shares and the Deferred capital, which is entitled to one-quarter of any distribution, £419,815 of the year's profits remained. But the general capital expenditure amounted to no less than £414,497, leaving only about £5,000 unappropriated and of that sum £1,297 was needed for providing against silicosis compensation.

Year to Dec. 31	*Tons Milled*	*Value*	*Working Costs per ton*	*Development Excl. Bird Reef*	*Bird Reef*	*Ore Reserves* Tons*	*Grade*
	(000)	*dwt.*	*s.*	*ft.*	*ft.*	(000)	*dwt.*
1955	2,804	2.27	33.14	55,292	74,253	5,900	3.2
1954	2,750	2.58	32.48	60,133	62,527	6,400	3.2
1953	2,651	2.76	31.91	46,331	49,745	6,600	3.3
1952	2,624	3.05	27.58	49,150	38,644	6,800	3.4

* Excluding shaft pillars and Bird Reef series

The annual report continues to give the ore reserve figures, but since they omit the ore reserve on the all-important uranium-bearing Bird series, the value of this information is severely restricted. The company is, of course, only observing the legislation imposed on it. At the end of 1955, reserves of gold-bearing ore alone were slightly lower at 5,900,000 tons than in the previous year, the average grade is the same at 3.2 dwt. per ton over a stoping width of 51 in. At the current rate of gold ore treatment, these reserves are equal to roughly three years' supply. The really important information is, of course, the reserves of the Bird reef series. This ought to be improving, since the development footage on that series has risen from 49,745 ft. in 1953, to 74,253 ft. and the percentage payable on combined gold/uranium has increased from 62.5 per cent to 86.5 per cent.

STILFONTEIN GOLD MINING COMPANY LIMITED

The next most important uranium profit earner in the enlarged General Mining orbit is Stilfontein Gold Mining, which owns 5,220 claims in the Klerksdorp area of the Transvaal. It is a comparative newcomer, having started production in July 1952. Currently it is milling 90,000 tons per month ; recently it extended the capacity of its reduction plant from 90,000 tons to 115,000 tons per month, but it has been unable to take advantage of the extra capacity because of the shortage of native labour. Ultimately it is planned to raise the capacity of this plant to 150,000 tons per month, but the programme will take 7 years to complete, and is dependent, of course, on additional native labour being available.

The finance for this projected extension will come, the Board believes, out of the company's own resources, without disturbing existing financial arrangements. It will, naturally, impose a heavy load of capital expenditure on the company over the next few years. In 1955, this item took £1,254,300 on gold account alone — the expenditure on capital expenditure for the uranium and acid plants are omitted since they are normally financed by way of loan. Nevertheless, the directors are confident that the new plans will not interfere with "the progressive improvement in the dividend rate". So far three dividends have been paid, the first at the end of 1954 and the others at half-yearly intervals since. Each dividend has been 6d. per share.

The company's plant has three different functions. First, there is the gold reduction plant already mentioned. Secondly,

The West Reduction Plant, West Rand Consolidated Mines Ltd. from the top of the Deep Shaft headgear

there is the uranium reduction plant which is large enough to treat the slimes from its own gold reduction plant and, in addition, from Ellaton, New Klerksdorp Gold, Babrosco and Afrikander Lease, all of which are planned to be at this stage comparatively small gold producers. The third function is the production of sulphuric acid, a material used in large quantities in the extraction of uranium ; the acid produced in this way is used both by Stilfontein and by other uranium producers. This side of the plant began operation in November, 1955. The daily capacity is now 225 tons of acid.

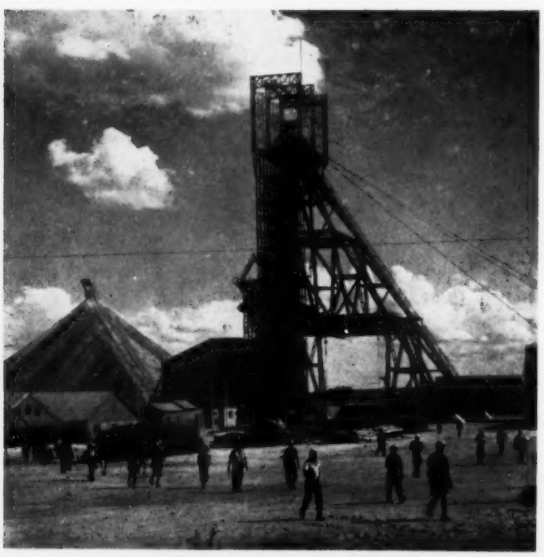
This threefold function of the plant and the treatment of slimes from other mines, and the sale of sulphuric acid to other uranium producers causes publication of profits and amortization allocations to be more complicated than usual. In the March, 1956, quarter, for example, the working profits from uranium and acid totalled £176,157, but interest and repayment of the uranium and acid loans amounted to £153,240. Of this latter sum, other participants in the joint scheme contributed £63,540, leaving Stilfontein to deduct £89,700 from its working profits to show a net accretion of £86,457 from acid and uranium.

The property is being developed by means of two shafts : the Charles shaft, which has been sunk to its final depth but is in what is believed to be rather poorer ground that the other shaft, Margaret. At one time it was thought that sinking the Margaret shaft to its final depth could be delayed, but the expansion programme requires the workings in depth to be more extensive sooner than was originally contemplated. In addition it has also been recently decided to sink and equip a series of incline shafts in the Margaret shaft area, so as to gain access to the upper levels and to the eastern areas of the mine.

In 1955, the production yielded £2,900,000 in profits, no tax being payable as yet, because of the heavy capital expenditure both in the past and currently. These earnings compare with £2,388,000 for the previous year. The juxtaposition of these profit figures show how radically Stilfontein differs from West Rand Consolidated, where uranium is the principal product. Further improvement in Stilfontein's uranium profits can be expected, since the plant went initially into operation only in January, 1955, and as it has to deal with complex ores from different mines, each presumably requiring different techniques, some time will have to pass before sufficient experience is gained. When that is done, profits from the production of uranium on behalf of all the contributors are expected to improve appreciably. The capital of the company consists of a single class of shares, each of 5s., £3,265,730 being in issue. In addition there was outstanding at the end of 1954, £1,527,400 5¼ per cent unsecured loan stock 1954-60, a loan of £1,000,000 from Anglo American Corporation, £500,000 from the National Finance Corporation of South Africa, a secured loan of £500,000 for mine housing, and the uranium loans, which will be extinguished under the existing arrangements, of £3,561,107.

ELLATON GOLD MINING COMPANY LIMITED

The Ellaton Gold mine is, in many ways, an astounding proposition. Its shares are held privately ; it is estimated that 60 per cent are held by the General Mining group, 20 per cent by Anglo American and 16 per cent by Anglo Transvaal Consolidated. The capital is small at £196,875, though it had also borrowed £2,500,000 from Anglo American. This loan is repayable by the allocation of two-thirds of the profits available for distribution in each financial year, and if profits are not sufficient to repay the loan by June, 1960, it must be redeemed by other means. Incidentally, finance for the erection of houses for employees has been raised from building-societies. The reason for the relatively small sum required to bring the mine to production, was the very shallow depth of the reef.



The Deep Shaft headgear at West Rand

It started off well, and by the end of June, 1954, had established ore reserves of 414,141 tons of an average grade of 9.14 dwt. per ton. A year later the quantity had grown to 567,000 tons, but the grade had fallen to 7.11 dwt. Inevitably the ore sent to the mill reflected this lower grade in the reserves, and gold profits fell away. To some extent that drop was made good by uranium profits, but total profits are now less than a year earlier. In the first nine months of the current year, gold profits amounted to £294,800 against £500,600 in the corresponding period of 1954-55, and uranium to £135,000 against £61,000. In the end, net profits came to £434,700 as compared with £561,600. Though the trend is the wrong way, the net profits for the whole of the current year will make a very favourable comparison with the capital of £196,975, mentioned above.

OTHER URANIUM INTERESTS

General Mining has an interest in the uranium producer, Babrosco, owner of 350 claims to the west of the township of Klerksdorp which pumps its slimes to the Stilfontein plant. Incidentally, two other uranium producers, New Klerksdorp Gold Estates and Afrikander Lease Mines also pump their slimes to the Stilfontein plant so that the profits of Stilfontein include those made from these three companies. It is unlikely that the total is very significant as the mines are not large.

The other uranium interests are in companies under the administration of other groups : President Brand, President Steyn and Western Holdings in the Anglo American sphere ; Doornfontein, Vogelstruisbult and West Driefontein in the " Goldfields " group ; Blyvooruitzicht and Harmony in the Central Mining orbit, and Virginia in the Anglo Transvaal circle.

SOUTH ROODEPOORT MAIN REEF AREAS

During the year to June 30, 1955, further leases were granted to South Roodepoort Main Areas, as a result of which the company at the end of 1954-55 had the right to mine a total of 2,202 claims. There are a few noteworthy features about this area. First, it is comparatively small by normal Rand standards. Second, the company has the right to mine only certain of the reefs in the Elsburg series on some of the claims, Johannesburg Consolidated Investment having the right to mine reefs other than those mentioned. Third, the property stands detached from the other mines, the nearest being Randfontein, the uranium producer to the west, and, to the north-east, Durban Deep.

Year to June 30	*Tons Milled*	*Grade dwt.*	*Development ft.*	*Payability %*	*Ore Reserves tons*	*dwt.*
1955	330,000	4.31	30,021	41.3	1,100,000	4.7
1954	328,000	4.34	30,431	42.4	1,140,000	4.7
1953	324,000	4.55	31,041	34.6	1,070,000	4.7
1952	325,000	4.47	28,769	37.9	1,110,000	4.6

Once again the grade of ore treated has fallen ; only once since 1947, when the grade was 5.17 dwt. per ton has the grade recovered and now it is down to 4.31 dwt. A slight increase in the throughput overcame part of the disadvantage of the latest decline, but the total output dropped by about 100 ounces. The average price received for gold was somewhat better, and revenue rose by approximately £4,500, but as costs jumped by about £6,400 working profits were roughly £1,900 down.

Year to June 30	*Revenue (gold etc.)*	*Working Profits*	*Capital Expenditure*	*Tax*	*Dividend*	*Carry Forward*
	£	£	£	£	%	£
1955	893,910	241,430	54,549	73,404	16¼	123,394
1954	889,462	243,118	19,408	110,898	15	127,889
1953	935,153	295,574	28,698	139,509	15	125,342
1952	936,941	299,471	43,399	150,874	15	109,419

The tax burden was, however, much lighter — £73,404 against £110,898 — and consequently net profits amounted to £165,483 as compared with £128,505. This was recognized by the dividend being raised from 15 per cent to 16¼ per cent, even though capital expenditure including £25,000 paid as lease consideration, rose to £54,549 from £19,408.

It is encouraging that the larger of the two annual payments, 8¼ per cent paid in June 1955, was repeated in December last.

The ore reserve position is fairly satisfactory, the decline in tonnage being virtually negligible and the grade and width remaining unchanged.

News from development work is not greatly different from previous years, but it has been disclosed that some development is now being done beyond the new lease boundary on Rietvalei 9, as it appears that the Saxon fault, which is the major disturbance cutting off the reef, is further to the north-west than originally estimated. Development on the Black reef, where the possibility of stoping operations was being examined, has been suspended because of discouraging results and the risk of encountering heavy water.

BUFFELSFONTEIN GOLD MINING COMPANY LIMITED

Following the intense activity in the Orange Free State and the Klerksdorp area since the war, there are now only a few developing mines left. Buffelsfontein is one of them ; its area of 4,889 claims lies between the Vaal River and Hartebeestfontein, which started production in July, 1955, and has made very rapid progress since. By March, 1956, it was milling 57,000 tons per month of an average grade of 9.48 dwt. per ton and yielding a working profit of £152,511.

According to borehole results the Buffelsfontein area has a better grade than its northern neighbour ; the average value of the boreholes on Buffelsfontein was 270 in-dwt. against Hartebeestfontein's 195 in-dwt. It seems likely, however, that the more southerly mine is the deeper, since the average depth of reef intersections in these boreholes was 5,614 ft. as compared with 4,461 ft. at Hartebeestfontein. Also it has the larger capital of the two.

At one time the financial structure could be rightly described as complex, but this has recently been simplified and the capital now consists of £5,500,000 in 10s. shares. This was increased during 1954-55 by the issue of 4,500,000 shares at 16s. each, bringing the number of issued shares up to 6,600,000. The holders of these shares were given the right to subscribe at 16s. per share during November 1955, for new shares in the proportion of two new shares for every three shares then held. No less than 99.43 per cent of holders exercised this option. At the date of the latest balance-sheet, Anglo American Corporation had lent the company £1,500,000, and had agreed to make available another loan not exceeding £1,000,000. These Anglo American loans are repayable by the allocation of 50 per cent of the profits available for distribution in each financial year, subject to repayment in full not later than May 31, 1966. This is the sort of arrangement which became popular in the Orange Free State, and which has been completed in the case of President Brand. A similar arrangement existed until recently with Hartebeestfontein, but this was revised. The two loans were merged into one, amounting to £2,100,000 ; a new interest rate was agreed and the consolidated loan is to be repaid by varying annual instalments which have been announced. It will be interesting to see whether any such agreement is reached after Buffelsfontein reaches production.

At first the property will be developed from two shafts, the Main and a Ventilation. The Ventilation shaft reached its final depth of 5,189 ft. last October, and the Main shaft touched 5,242 ft. last February. Only very limited development has been done as yet, though the initial results from this small footage have been 100 per cent payable ; full scale development is expected to start towards the middle of the year, and it is anticipated that trial milling will commence during the latter half of the year.

GENERAL EXPLORATION ORANGE FREE STATE LIMITED

The current assets valued at the end of 1954 at £531,162 in the books of General Exploration Orange Free State, and the quoted investments, carried in the books at £198,192 and valued by the market at £266,735, are of less general interest than the various properties and mineral rights, and option and participation rights.

The main properties owned by " Geoffries ", to give the company its usual market name, are centred to the north-west of the town of Odensdaalsrus and include the freehold title to the farms Spes Bona, Rosedale, Weltevreden and Welgevonden, covering approximately 2,650 morgen. It holds mineral rights in the Hoopstad, Kroonstad, Ventersburg and Winburg districts, over a total area of 2,514 morgen. In addition, it has participation rights in net vendor consideration and subscription

Filtering the final product in the uranium plant, West Rand

rights over an area of roughly 2,900 morgen in the Hoopstad, Kroonstad and Ventersburg districts.

Ownership in some of these rights is likely to change hands and the composition of " Geoffries " balance-sheet to change, since Middle Witwatersrand (Western Areas) — a company in the Anglo Transvaal group — and " Geoffries " have agreed on the formation of a company, to be known as Riebeeck Gold Mining Company. This company will be under the administration of Anglo Transvaal Consolidated, and it will apply for a mining lease in respect of farms van den Heeversrust 410, Klein Begin 111, and portions of farms Welgevonden 183, Weltevreden 205, Spes Bona 210, Rosedale 298, and Britzpan 228.

Fuller details of this new company have been promised and when they are published, holders of " Geoffries " shares will have a clearer idea how the new venture affects their own company. Under an agreement reached earlier, Middle Wits and " Geoffries " provided that any company formed to exploit the van den Heeversrust area would be under the administration of Anglo Transvaal but that if the area were found to be large enough to support a second mine, it would be under the management of General Mining and Finance. It seems that no decision concerning a second mine can be made until some underground development has been done on the Riebeeck mine, and that is some time ahead. The reason for thinking that such a decision will be delayed is the intriguing nature of the reefs underlying the farms. Boreholes sunk some years ago disclosed reef intersections at a number of depths, and this phenomenon gave rise to the name " Rainbow " reefs. It will probably also pose a number of extremely interesting mining problems.

NEW PIONEER CENTRAL RAND GOLD MINING

In the consolidated accounts apart from liquid assets, which at the end of June 1955, exceeded current liabilities and provisions by only £17,000, the assets belonging to New Pioneer Central Rand Gold Mining fall into two broad classes. First, and probably more important, are the investments. Quoted investments were carried in the books at end-June last at £885,000 and the unquoted at £222,000. This is a fall of about £150,000 in the book value of unquoted investments, and a rise of £370,000 in the quoted investments. This switch follows largely on the transfer of Buffelsfontein Gold Mining shares to the quoted list and on the increase in the company's holding of Hartebeestfontein shares acquired by exercise of options to take up two further shares for every three shares held. To finance this extra holding, New Pioneer was obliged to borrow more money and, in the latest balance-sheet, loan liability is shown at £210,000 against £45,000. The market value of these quoted investments at June 30, 1955, was £2,358,046. Thus after allowing for the loan liability just mentioned the market value of the quoted securities alone exceeded £2,000,000 as compared with the nominal value of the issued capital of £500,000.

This comparison ignores two significant factors. First, on the balance-sheet is a note concerning contingent liabilities in respect of guarantees, the chief being for loans to associated companies, £868,956. The second is, of course, the other main class of assets that is to say immovable assets. These include, through a wholly owned subsidiary, a 22 per cent interest in the Lucas Block, 3,481 morgen in extent ; 275 precious metal claims on Rietkuil 86, district Klerksdorp ; and various interests in land in the Stilfontein area including the township.

Johannesburg Consolidated Investment Co. Ltd.

THE interests of the Johannesburg Consolidated Investment Company range through gold, uranium, coal, diamond, copper and platinum mining to a substantial participation in the brewing industry of South Africa with lead-zinc mining in the U.K. and Eire thrown in to add variety. Insufficient attention seems to be paid to the breadth of these interests at times, for in the investment context the shares have tended to become closely identified with the affairs of the unfortunate Freddies Consolidated Mines. This is not to deny that the company's holding of the capital of Freddies Consolidated is not important (in November, 1955, it held approximately 45.7 per cent. of the issued capital); its impact on more recent balance sheets and profit and loss accounts has been too marked for it to be regarded as otherwise—but it is equally essential that the strength of Johannesburg Consolidated in other respects should not be forgotten.

The position is best considered in the light of figures given in the balance sheet dated June 30, 1955. The book value of quoted investments was then based on cost, Stock Exchange value or the directors' valuation, whichever was the lowest. For tax purposes the holding of 7,479,528 £1 shares of Freddies Consolidated was valued at the market price of 6s. 9d. ruling on that date, a total of £2,524,340, and it is fair to suppose that this was also the book value. The book value of the shareholding in Freddies Consolidated thus accounted for less than one quarter of the value of £10,503,612 at which investments other than in subsidiaries were carried in the balance sheet and, still more important, for only about 13½ per cent. of the market value of the quoted investments, then calculated at £18,594,431. Another instructive way of looking at the position of the company is the asset backing of the Ordinary Capital.

The balance sheet asset total on June 30, 1955, was £15,524,076, to which may be added £9,183,915 of unrealized appreciation in quoted investments, and from which there falls to be deducted current liabilities of £824,593 and £1,880,000 of 4½ per cent. Unsecured Loan stock, giving a net total of £22,003,398. Issued capital is £5,266,666 in £1 shares, and there was thus about 83s. 6d. of assets behind each £1 of capital. The situation insofar as the holding of Freddies Consolidated is concerned has deteriorated since the date of the last accounts, the shares having fallen to 3s. 9d., but even if the investment in Freddies Consolidated is given no value at all, and even if it is assumed that Johannesburg Consolidated will have to implement its guarantee of the £1,000,000 advanced by the National Finance Corporation of South Africa to Freddies Consolidated, net assets would still be worth £18,479,058, equal to about 70s. 2d. per share. Finally, on the question of the other investments of the company, it is appropriate to record that they yielded an income of £1,461,857 during the year to June 30, 1955, compared with £1,274,893 in the previous year, and that in the light of subsequent declarations by Randfontein and the copper companies dividend income should be higher this year.

REVISED METHOD OF VALUING INVESTMENTS

The past year saw one major change in the position through the adoption for tax purposes of a revised method of valuing investments, resulting not only in the elimination of all U.K. tax liability for the year to June 30, 1955, other than the Profits Tax distribution charge which was offset by double taxation relief, but also the recovery of substantial tax payments made in earlier years. Up to June 30, 1954, Johannesburg Consolidated had always valued its investments at cost for the purpose of assessing taxation, such valuation being in the aggregate less than the market value, the Inland Revenue authorities contending that cost or market value, whichever was the lower, must be applied to the holdings in the aggregate and not individually. Recent case law on the subject of valuing items of stock in trade for tax purposes, however, has favoured a method of valuation which closely resembles that adopted by the company in respect of investments in its accounts, namely that the lower of cost or market value can be applied for tax purposes to individual items of stock, and in view of the heavy fall in the market value of its holding of Freddies Consolidated shares the company requested the tax authorities to apply this decision to the valuation of its investments in calculating outstanding tax liabilities, with the result that it was able to bring back into profit and loss account £1,800,000 provided for U.K. taxation in earlier years.

Although, as already mentioned, dividends and interest received increased by £186,964 to £1,461,857 last year, total revenue declined by £227,023 to £2,104,314, as neither investment realization nor fees and sundry revenue yielded as much as in 1953/54. After allowing for miscellaneous outgoings of £176,053, of which £86,400 was accounted for by gross interest on Loan Stock and £14,655 by depreciation of fixed assets, the amount available became £1,928,261. No provision required to be made for United Kingdom taxation, £158,000 provided for profits tax being entirely offset by double tax relief, and the only tax charge was £46,425 directly assessed on the company by South Africa and Rhodesia, leaving a net balance of £1,881,836. In such circumstances it may at first glance appear to be a little surprising that it was found necessary to reduce the dividend by 6d. to 3s. per share, but the operative factor was the obligation to provide £4,938,118 in reduction of the book value of investments. Of this sum, £1,467,804 was available in the investment reserve, and the U.K. tax credit of £1,800,000 made this up to £3,267,804, leaving £1,670,314 to be provided out of the year's earnings. The net revenue balance of £1,881,836 for the year was thus reduced to £211,522, whereas the reduced dividend of 3s. cost £454,250 net. In the circumstances maintenance of the dividend could hardly be justified, even though the cash position remained very strong.

At the annual meeting in November last, however, the chairman expressed the hope that the rate of dividend can at least be maintained at the present level, and the inclusion of the words "at least" can perhaps be taken as an indication that it will be restored to its former rate as soon as possible.

RANDFONTEIN ESTATES GOLD MINING

From the aspect of revenue one of the more important of the company's investments in gold and uranium mining is its holding of Randfontein Estates Gold Mining shares. It has moreover been a particularly profitable one during the past year, for the two dividends declared by that company during 1955 totalled 4s. 6d. per share, compared with 3s. in 1954, the year in which production of uranium began. For all practical purposes Randfontein is now an uranium mine, though it is still treating for gold recovery a certain, but unknown, tonnage from reefs which do not carry uranium. In this connection it is important to bear in mind that losses on the production of gold reported by the company up to September 30, 1955 did not necessarily mean that these non-uranium reefs had become unpayable. In the case of the uranium bearing reefs the practice was and still is to charge to gold account all the costs incurred up to the point at which the residues from the gold extraction plant pass to the uranium treatment plant. The ore, which is mined primarily for its uranium content, contains a small quantity of gold, but insufficient to make it payable, and the losses arose because the deficit on developing, mining and milling this ore was charged entirely to the gold account.

As long ago as September 30, 1955, the company adopted a different method of presentation of the gold and uranium figures in its quarterly reports whereby to the revenue from gold is added the net revenue from uranium and acid and from the resulting sub-total the working costs are deducted to give the overall working profit for the quarter. This method of presentation lines up with that adopted by the company in its 1955 Annual Reports and Accounts. The final working profit figure is the important item, and this has shown a sustained improvement throughout the past year, rising from £265,442 for the first quarter of 1955 to £300,842 for the first three months of this year after providing for interest on and repayment of the uranium loans. Earnings per share for 1955 worked out at 5s. 11d., but the equivalent of 1s. 2d. per share was spent on capital account other than on the uranium plant, and there was thus some 4s. 9d. available for dividends. The distribution of 4s. 6d. was therefore a fairly full distribution of profits.

It has been said that for all practical purposes Randfontein is an uranium mine, and the justification for this is that though some ore is being milled for its gold content alone, the indications are that such operations are gradually coming to an end. The footage sampled on reefs other than the Bird series, which carry the uranium values, declined from 12,560 feet in 1954 to 5,120 feet last year, and ore reserves on these horizons, which had fallen by 950,000 tons in the earlier year, were further reduced by 747,000 tons last year. An increase in the average value of these reserves from 3.4 dwt. to 3.7 dwt. suggests that an increase in the pay limit and the consequent exclusion from the reserves of low grade tonnage may have been partly responsible for the fall, but the conclusion must be that the non-uranium reefs will gradually disappear from Randfontein's operations, probably without having any major effect on the overall profitability of the mine.

One major uncertainty is the extent to which the company will become liable to taxation on its mining income. By the end of 1955, £7,119,840 had been spent on the uranium project, and as most of this expenditure has been available as a set off against profits for tax purposes the company has not been liable to tax on its mining income since 1952. It is expected, however, that the profits for 1956 will exceed the accumulated loss for tax purposes at the end of 1955 and that a small amount of tax will become payable in respect of 1956. A charge for tax on mining income is thus likely to make its appearance in the quarterly statements sometime this year. Under the provisions of the Atomic Energy Act, the company is precluded from giving estimates of its future revenue from uranium and it is thus not possible to make even an approximate estimate of the proportion of future operating profits which will be absorbed by taxation, nor consequently to venture a guess at the amount which will be available for dividends when full liability is incurred. The bright side of the picture is that the company is assured of profitable production of uranium for at least another nine years, since the contract with the U.K. and U.S.A. authorities extends until December 31, 1964.

OTHER GOLD-URANIUM INTERESTS

The other uranium producing company of the group is East Champ d'Or Gold Mining, a relatively small concern which has been milling at the rate of about 17,000 tons per month in recent times. Production of uranium from the company's slimes takes place at the Randfontein plant. Difficulties prevented the company from deriving much benefit during the initial period, but 1955 saw a substantial building up of profits from uranium, the net revenue from which after loan charges totalled £493,084 for the year against £297,460 in 1954, though this was partly offset by growing losses on gold production. The net profit for the year after taxation was £95,812, which was sufficient to enable the company to resume dividends with a declaration of 3d. in June, 1955, followed by 4d. in December, 1955, the two payments requiring £60,637. The remaining ore on the Main Reef series, which does not carry uranium, was stated to be insufficient to constitute an ore reserve, and operations on this reef series will cease as soon as the limited number of stope faces still available fails to yield a profit. Operations are now mainly concentrated on the Bird Reef Series which carry the uranium values.

The financial results of the production of pyrite by Government Gold Mining Areas steadily improved up to the first quarter of 1955, but from then suffered a setback owing to metallurgical difficulties, but these have now been largely resolved. A recovery in earnings from pyrite has since occurred, but with gold mining operations also less profitable, as was to be expected now that the mine has reached an advanced stage of its life, dividends declared were halved at 7½d. per share. Ore reserves were further reduced during the year by 1,549,000 tons, partly, it would seem, because of an increase in the pay limit, and at 3,797,000 tons they now represent about fifteen months' supply for the mill at the 1955 rate of treatment.

FREDDIES CONSOLIDATED MINES

The immediate financial problems of Freddies Consolidated Mines were eased when in March, 1955, it arranged to sell certain assets including 1,300 claims in the southern section of the property and the No. 2 South shaft to Free State Geduld Mines for £1,500,000 which was utilized in subscribing for 300,000 shares of that company. The proceeds of periodic sales of these shares to Johannesburg Consolidated Investment and Anglo American Corporation of South Africa have enabled the company to continue the development of the more promising part of the remaining area, but it can hardly be said that the results have held out much hope that the mine will develop into a paying proposition.

Development work and stoping in the southern section (the old Freddies South mine) has now ceased, the No. 2 South shaft has been handed over to Free State Geduld Mines, and the No. 1 South shaft will be shut down as soon as all equipment has been removed. From the mining point of view the future depends entirely on the course of development in the northern area, and while the situation here cannot yet be described as hopeless, the omens are certainly not favourable. The faulting disclosed by development in that area is severe and there are as yet no indications that any areas free from faulting are likely to be found. Development values have admittedly shown some improvement, and the tonnage of ore in reserve in this section increased during the year from 505,600 tons to 767,800 tons, but even to a mine not afflicted with the particular difficulties which beset Freddies Consolidated, the average value of 5 dwt. over 41 inches would still be only a little on the right side of the pay limit.

The peculiarity of the northern sector of the O.F.S. field is that a band of soft shale overlies the reef. In the Freddies Consolidated mine there is an average thickness of eight inches of quartzite between the Basal reef and the shale, and this in the normal way would be sufficient to prevent dilution of the ore, since the quartzite will hold the shale in place with ordinary supports. There is unfortunately extensive minor faulting, with the result that the quartzite frequently becomes too thin to provide the necessary temporary support or it disappears altogether, and this involves heavy expenditure in respect of the removal of the shale in the danger spots. Costs of production recently have been running around 69s. per ton milled without taking into account excess development, which is charged to capital account, while stoping difficulties have prevented recovery from rising much above 3.4 dwt. In consequence recent monthly losses on gold account have been around £50,000 and an additional £36,000 per month has been spent on excess development.

Uranium production has helped the mine to continue in existence, but the net revenue from this venture, which reached £45,000 in the March, 1956, quarter, before charging interest but after allowing for amortization charges, have come in the past partly from accumulated slimes, and the quantity to be processed during the current year is expected to decline by reason of the exhaustion of these "reserves" and because the Welkom plant, at which extraction takes place, will be needed to an increasing degree by other companies. In consequence a considerable drop in future earnings from this source is to be expected.

One immediate problem, and one which has an important bearing on the future of the company, is finance. By the end of March, 1956, the holding of Free State Geduld shares had been reduced to 70,000 shares, the sale of 35,000 during the first quarter of 1956 to the two companies mentioned above following the disposal of 50,000 during the last quarter of 1955. In March, 1956, two hoists at No. 1 South shaft were sold for £240,000 payable by mid-April, 1956.

When operations have been stabilized on the basis of working the northern section only it will be possible to determine whether, on such a basis, present working losses can be extinguished. Sufficient funds are available to enable this proposal to be put into operation and to ascertain clearly the results which may be expected from it. The Directors have reported recently that operations will be continued only if there are reasonable grounds to hope that a material improvement in the present position may result. If a decision to cease operations in the Northern section has to be taken later, the mine might then be placed on a care and maintenance basis until such time as the price of gold holds out a promise that it can be operated at a profit.

FREE STATE DEVELOPMENT AND INVESTMENT CORPORATION

The original raison d'etre for Free State Development and Investment ("Freddies") was the prospecting of areas in the Orange Free State, and as such it was immediately responsible for the formation of the Freddies North and South companies, now merged into Freddies Consolidated Mines. It remains an important holder of the shares in the last named company, the holding at March 31, 1955 having been 775,460 shares, the increase from the figure of 656,999 shares held in June, 1954, being due in the main to the subscription of the issue for cash made by Freddies Consolidated in September, 1954. In addition "Freddies" continued to hold 59,552 5s. shares and £8,630 of 6 per cent. Notes of Harmony Gold Mining, 300,000 5s. shares of Odendaalsrus Gold, General Investments and Extensions, 38,605 5s. stock units of Merriespruit (Orange Free State) Gold Mining, and 176,831 5s. stock units of Virginia Orange Free State Gold Mining, the only change in these items during the year having been the reduction of the last-named by 39,793 units. Apart from Odendaalsrus Gold all these are marketable stocks, and the Stock Exchange value of the quoted investments at the date of the balance sheet was £545,867, against a book value of £1,149,801. In addition the company owns mineral rights over a total of 18,931 morgen, of which 11,900 morgen in the Odendaalsrus, Ventursburg and Bothaville districts have not yet been turned to account. There were outstanding at the same date prospecting contracts over 1,800 morgen and participations in areas totalling another 4,118 morgen.

The most interesting development in the company's affairs during the past year was the announcement that it has obtained a 20 per cent. participation in a prospecting operation which Johannesburg Consolidated Investment has undertaken in the "Far West Rand" and will bear 20 per cent. of the expenses of the prospect. At the meeting of Johannesburg Consolidated

in November last it was stated that in the area in question consisting of the farms Modderfontein 4, Waterpan 45 and Jachtfontein 99, its centre being situated about 18 miles due south of the town of Randfontein, a complicated geological problem was presented by reason of the number of reef horizons involved and assessment of its worth must await the results of further drilling and that the disclosure of incomplete and inconclusive information would not be in the best interests of shareholders.

RUSTENBURG PLATINUM

As a shareholder in Potgietersrust Platinums and as Consulting Engineers to that company and to Rustenburg Platinum Mines, Johannesburg Consolidated Investment is closely interested in and associated with the production of platinum and allied metals by Rustenburg Platinum Mines, in which Potgietersrust has a 43.3 per cent interest. The year to August 31, 1955, brought the first major benefit of the expansion of refining capacity in line with the mine extensions made previously, and Rustenburg, which had been accumulating concentrates, was able to make some progress in the reduction of these stocks of matte. Rather surprisingly net revenue from sales of metals decreased from £3,399,714 in 1953/54 to £2,832,430 last year, the biggest factor being a reduction in the average price realized for platinum and other products. The company was, however, able to transfer from stock realization reserve the sum of £280,645 in respect of a decrease in unrealised stocks at the close of the year, instead of having to place £569,164 to that reserve. In addition, the State's share of profits and taxes cost less and revenue appropriated for capital expenditure was smaller, the amount appropriated being £310,656 instead of £534,576. The company distributed £1,373,600 to its shareholders as dividend, an increase of £161,600 over the previous year. The dividend was raised by 4s. to 34s. per share.

Rustenburg Platinum has taken the view that during the next few years the productive capacity of the mines will fall short of the needs of its customers. For that reason they have already taken steps to expand production, and it is anticipated that by the end of 1956 mine output will be 50 per cent higher than in 1955. The attendant increase in refinery capacity is not expected to be reached until the first half of next year and there will be no significant increase in the quantity of metal available for sale during the financial year ending August, 1956. Next year should, however, see a material advance in sales.

The cost of this fresh increase in production and of completing the previous expansion programme is estimated at £2,250,000 to be spread over the two years ending August, 1957. Of this sum, approximately £1,000,000 has been obtained by an issue of 60,600 shares at £17 per share to the three companies which own the capital of Rustenburg, and the balance will come out of profits. The three companies holding the capital of Rustenburg in turn have made issues to their own shareholders; that by Potgietersrust Platinums consisted of one new share at 8s. per share for each ten shares held.

OTHER INTERESTS

Johannesburg Consolidated's participation in the diamond industry includes a holding of De Beers Consolidated Mines Deferred shares, the dividend on which was maintained at 10s. per share for 1955, although world sales of stones reached a new high record of over £74,000,000. The copper interests have, however, been more profitable and they include investments in Nchanga Consolidated Mines, Rhokana Corporation, and Rhodesian Anglo American, all of which have increased their distributions as a result of the big advance in the price of the metal.

Another major interest of Johannesburg Consolidated Investment is in South African Breweries, which maintained its dividend at 18½ per cent for the year to March 31, 1955, and has since repeated the interim dividend for the subsequent year at 5 per cent. The Company has made offers to the shareholders of Ohlsson's Cape Breweries and Union Breweries to acquire their shares in exchange for South African Breweries shares, a move which should enable considerable economies to be achieved in due course.

The operations of the collieries of the group continued to be affected by a shortage of rail transport and restrictions on the export of coal. The output sold by the operating mines during the year 1954/55 totalled 1,922,000 tons compared with 1,876,000 tons in the preceding year.

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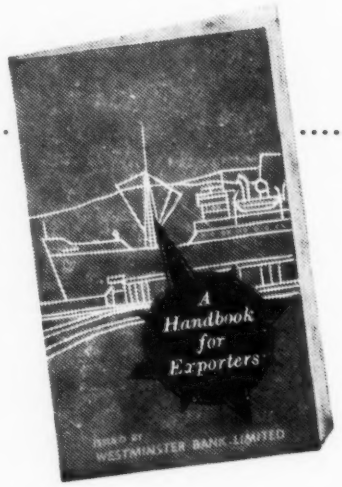

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New Union Goldfields Ltd.

POTENTIALLY RICH INVESTMENT PORTFOLIO

As certain of the New Union Goldfield's interests in the Orange Free State and Transvaal developing gold and uranium mining companies reach the dividend paying stage, it remains only a matter of time before the company itself reaches a stage at which the question of a dividend distribution might be considered. Indeed, in view of the progress made since 1952 when net profits earned were only £67,022 compared with £183,346 in 1955, New Union's hope that dividends on a modest scale might start—if not during the current year then next year—is obviously well founded. Yet it is necessary to bear in mind the fact that in building up its valuable investment portfolio, the company's financial resources have inevitably been somewhat strained.

POLICY IS TO BUILD UP RESERVES

Before anything else, therefore, the company's financial position must be strengthened by building up a substantial reserve against unforeseen setbacks. This is most necessary for a group with so high a proportion of its funds invested in new mining areas, where unforeseen technical difficulties may be encountered. In addition, the company's progressive policy demands that sufficient liquid funds should be readily available for any interesting participations or exploration ventures which might arise. While the outlook for New Union is now more reassuring than at any time since the first Judicial Managers' Report in 1947, it would be wise to temper confidence in the future with a measure of patience.

By far the company's most valuable asset is its investment portfolio. While the most important section of these securities consists of direct and indirect holdings in developing and producing gold and/or uranium mines in the O.F.S. and the Transvaal—which have yet to pay dividends bearing a closer relationship to their present market values—the time is not far off when substantial yields will be forthcoming on funds invested.

Besides acting in an administrative capacity as managers, secretaries and consulting engineers to many companies, New Union owns potentially valuable mineral and other rights over areas in the Transvaal, Orange Free State, and Swaziland. Included in these holdings are participations in several areas from which mining companies may emerge in the near-term future.

New Union also holds shares in companies engaged in tin and diamond mining in South Africa as well as in the leather industry, farming and real estate concerns.

The balance sheet figures for New Union at June 30, 1955, showed total assets at £3,309,795 compared with £2,961,411 at June 30, 1954. Of this total quoted investments represented £2,245,627 against £1,847,644. These securities had a market value of £3,238,475 against £2,443,532 previously. Unquoted investments were entered at £566,531 against £377,412 in addition to which mineral rights, options, participations, subscription and other rights at cost, less sales and amounts written off, amounted to £29,313 against £31,035. Current assets—including cash of £56,494—at £329,340 exceeded current liabilities by £54,482.

During the past year ended June 30, 1955, the decline by £29,000 in dividend and interest received was more apparent than real. In fact it only took place because the 1954 accounts contained two dividends on the very substantial shareholding in New Witwatersrand Gold Exploration. No dividend was therefore received in 1954/55. This position will, however, revert to normal in respect of the current year. Indeed, with the prospect of increased dividends being paid by its associated companies, New Union's income from this source during 1956 is expected to show an improvement.

HARMONY MINE THE LEADING GOLD INVESTMENT

New Union's leading gold investment lies in Harmony Gold Mining. As at October 28, 1955, its direct shareholding in this company had a market valuation of £558,000. Amongst the company's other more important interests in gold-uranium mining, and mining-finance companies at June 30, 1955 were Anglo-Rand Mining and Finance, Dominion Reefs (Klerksdorp), Lydenburg Gold Farms, Middlevlei Estate and Gold Mining, New Free State Gold Estates, New Witwatersrand Gold Exploration, Wit Extensions, Witwatersrand Deep, Free State Geduld Mines, General Exploration Orange Free State, President Brand Gold Mining and Union Corporation.

Through its holding in New Witwatersrand Gold Exploration and Lydenburg Gold Farms, New Union is substantially interested *inter alia* in Blyvooruitzicht, West Driefontein and Village Main Reef Gold Mining Companies.

The company's most important direct interest in uranium is represented by its stake in Dominion Reefs (Klerksdorp).

Shareholdings in a number of group associated companies were again increased during the past financial year. This particularly applied in the cases of New Witwatersrand Gold Exploration, Lydenburg Gold Farms and Dominion Reefs (Klerksdorp).

As the result of rights which accrued to New Union through its shareholdings in New Witwatersrand Gold Exploration, New Free State Gold Estates and the H.E. Proprietary (plus a few additional shares) the company acquired 422,000 shares at par in Free State Saaiplaas Gold Mining since the end of the past financial year. This new and promising mine, floated under the ægis of New Consolidated Gold Fields, is regarded as an extremely valuable addition to the Group's investment portfolio.

PROSPECTIVE MINING AREAS

Either directly, or through its associated companies, New Union is interested in several prospective mining areas, notably Van Den Heever's Rust in the O.F.S., Bethal on the Far East Rand and the "Composite Mineral Area" to the south of Blyvooruitzicht and West Driefontein on the West Wits Line. Certain developments of interest took place during the past year at all three of these areas.

It was announced from Van Den Heever's Rust that the consulting engineers to Middle Witwatersrand (Western Areas) had submitted to the consulting engineer of General Mining and Finance Corporation estimates and proposals for the demarcation of a mining area in this vicinity.

The recent flotation by Union Corporation of Winkelhaak Mines in the Bethal area has spotlighted drilling and other exploration work being carried out in this interesting new field. New Union's interest in Bethal flows partly from its holdings in Anglo-Rand Mining and Finance Corporation and The Beatrice Gold Mining Company and also directly from the company's own mineral and other rights in the area.

During the past financial year, New Union's associated company, Witwatersrand Deep, concluded an agreement with Western Ultra Deep levels regarding the "Composite Mineral Area." In the terms of this agreement Witwatersrand Deep becomes entitled to a net 11¼ per cent. of the total vendor consideration and 5.4 per cent. of the total subscription rights in any company formed to work the area. In addition New Witwatersrand Gold Exploration has a minor particpiation in the subscription rights.

DIAMOND AND TIN INTERESTS

Through its direct and indirect shareholding in the Selected Mining Holdings, New Union continues to be interested in that company's wholly owned subsidiary, Star Diamonds (Proprietary). During the year ended June 30, 1955, Star Diamonds merged its property with that of its western neighbour, Westar Diamond Mining Company. The latter company was subsequently placed into voluntary liquidation.

The company acts as managers and consulting engineers to two small tin properties—Union Tin Mines and Vellefontein Tin Mining. Both of these mines showed improved results during the year 1954/55. While this was mainly due to more efficient mining and plant operational methods, the fact that world tin markets were more stable was a large contributory factor.

INDUSTRIAL COMPANIES

The principal industrial companies in which New Union is now directly or indirectly interested are Silverton Tannery, S.A. Grain and Seeds Distributors and P. J. Joubert. Shares are also held in New Vaal Farms and New Durban Gold and Industrials, the latter company being interested in township property in Durban, Natal, through its wholly owned subsidiary, The Modern Town Planning Company Ltd.

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New Kleinfontein Company Limited

NEW KLEINFONTEIN has some claim to uniqueness in that is is, among the major gold mines of the Rand, one of the only two companies that come outside the orbit of the big mining finance houses. There are certainly no signs that this has proved anything of a handicap. In fact, the present management which took control in 1931, has pursued an active and progressive policy that has brought the company many years of steady dividend-paying. It is no fault of the directors, headed by Mr. George Mackenie, that the mine has now fallen on lean times. As a low-grade proposition it has been caught, along with many other Rand mines, in the profit-squeezing process caused by rising costs in a world-wide inflationary period which has seen since 1949 no compensating increase in the price of gold. After the disappearance of premium sales of the metal towards the end of 1953 the mines have actually been getting less for their product. It is all credit to the management that the cost of milling a ton of ore at New Kleinfontein has been kept down below 30s. The average figure for 1955 was 28s. 11d. This compares with the industry's average for that year of 40s. 5d. per ton and averages of 40s. and 40s. 7d. respectively for the two adjoining producers, Brakpan and Van Dyk.

IMPORTANCE OF SOUTH-WESTERN SECTION

New Kleinfontein's property is situated in the north-eastern Rand. It now consists of 3,566 mining claims, 141 morgen freehold and certain water rights. When the company was formed in 1894 only 151 claims were owned. These were in the northern part of the present property. Plant capacity at that time was no more than 4,000 tons of ore monthly. It is now 125,000 tons. A substantial proportion of the company's ground is worked out, including all the old claims in the north. The future is becoming increasingly dependent on the south-western section of the mine where the reefs towards the former Boksburg "gap" (occupied in recent times rather unsuccessfully by Van Dyk Consolidated) tend to string out and show only a low percentage of payability and modest gold values of under 200 inch-dwts. This factor, together with the rising pay limit caused by higher costs, has brought about a dwindling in the ore reserves. The devaluation of sterling in 1949 and the consequent increase in the gold price boosted the reserves to over the 3,000,000 ton mark. At the end of 1955 the tonnage had fallen to 2,209,000 tons with an average gold content of 3 dwts. per ton calculated over a stoping, or extraction, width of 44 inches. In 1951 the grade was 3.3 dwts. The latest tonnage figure does not include 167,000 tons in shaft and safety pillars at present unavailable for extraction. This ore averages 3.8 dwts. over 55 inches.

In 1955 New Kleinfontein crushed 1,277,000 tons of ore, appreciably less than the 1,500,000 tons plant capacity. At last year's milling rate the ore reserves represent about 1¾ years' supply for the plant. In 1953 the mine was making a profit of 5s. per ton. Last year this margin had fallen to slightly under 1s., a combination of higher costs, 28s. 11d. against 27s. 4d., and a decline in the grade of ore treated. In 1955, 2.379 dwts. of gold per ton were extracted. In 1953 the figure was 2.571 dwts.

BENEFITS FROM PLANT EXTENSIONS AND IMPROVEMENTS

In his statement to shareholders accompanying the 1955 report, the chairman points out that the rise of 6s. 6d. in costs per ton from 22s. 5d. to 28s. 11d. since 1949 is equivalent to about £415,000 on the 1955 tonnage. What this sum means becomes clear when compared with last year's working profit of £62,318, a profit which was less than a fifth that earned as recently as 1953. The chairman went on to point out that the advance in costs would have been even greater had it not been for the benefits derived from the plant extensions and improvements made at the mine coupled with rigid control of expenses and general economies in working. Dividends for 1955 totalled 6d. per share against 1s. 6d. in 1954 and 2s. 6d. in 1953. The 1955 dividend required £43,375, so that it was well within the capacity of the net profit of £61,966 after tax and State's share of earnings. These latter items have now dwindled to negligible proportions. Last year only £1,033 was absorbed under these headings.

Being an old mine New Kleinfontein has now reached the position in relation to the Silicosis Outstanding Liabilities Trust Fund (a compulsory Government fund for the compensation of miners who contract this disease) whereby it obtains annual refunds of excess contributions. Last year this refund amounted to £25,850. Some of the older Rand mines utilize such sums in boosting their dividends. This is not at present the practice at New Kleinfontein. Last year the refund went towards swelling the carry forward which was raised from £137,366 to £180,536.

The company has to keep a close eye on its financial situation. At December 31 last current assets of £399,839 exceeded current liabilities by £202,928, but it has to be noted that £261,895 of the assets were represented by stores and materials on hand. In other words there was an actual cash deficit of £58,967, yet there is no need for the company at this stage of its life to carry large amounts of liquid funds as the capital expenditure programme, inaugurated in 1950, has now come to an end.

Shareholders should thus gain full benefit from New Kleinfontein's future earnings. The big question mark is how long these earnings are going to continue. Estimates of mining lives in the South African gold field used to be made many years ago with a fair degree of confidence and accuracy. Now, however, any such estimates are largely a plunge into the unknown economic future of the world at large. It is obvious that much further worsening of the costs factor could tip mines such as Kleinfontein into the red. Once this occurs for any length of time a vital decision has to be made.

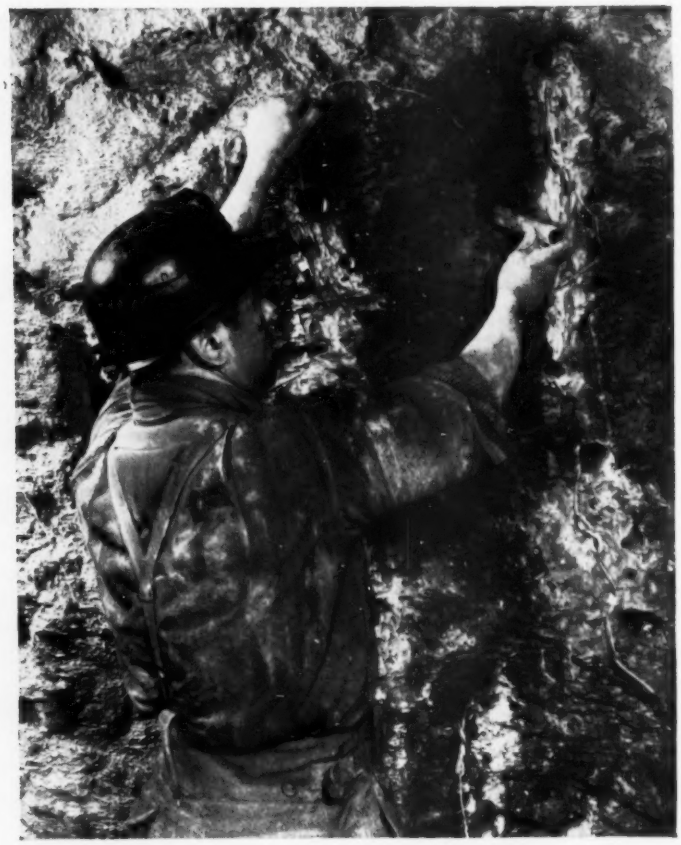
LOW PROFIT MARGIN

New Kleinfontein, of course, is not yet anywhere near the stage when the directors even have to think about any such decision. But, as the chairman has pointed out, the company must be particularly vulnerable with its profit per ton margin now under 1s. to any further advance in costs. The President of the Transvaal and Orange Free State Chamber of Mines, in fact, has recently said that the period of continued profitable operations of the sixteen mines on the Rand which had a profit margin of less than 5s. per ton must be "very short" if the costs rise continues. This is not a prospect to be faced with equanimity by the South African Government. Its greatest national asset is a wasting one and there is a consequent understandable desire to get every possible ounce of gold out of the mines. A rising limit of payability caused by increasing costs means that more and more ore becomes uneconomic to extract and its gold content, sizeable in the aggregate, consequently has to be abandoned, perhaps for ever. It is difficult, however, to see what the Government can do for mines such as New Kleinfontein which already pay virtually no tax unless some kind of subsidy is introduced. This has been done in other gold fields of the world, in Canada and Australia, for instance. But it never seems to have been given much serious thought in South Africa.

EFFICIENT MANAGEMENT

Thanks to the management's efficiency Kleinfontein is able narrowly to pay its way with a gold extraction of only 2.34 dwts. per ton of ore crushed. This is substantially below the average value of the ore reserves (3 dwts.), but it has to be realized that these old mines often find it difficult to maintain any tight control over the grade of ore going to the mill. The scope for selective mining, in other words, grows less and less as the property becomes worked out. Since milling started in 1894 Kleinfontein has crushed over 41,000,000 tons of ore for rather more than 8,400,000 ounces of gold. Total revenue has surpassed the £55,000,000 mark and working costs have aggregated over £44,000,000 exclusive of capital expenditure. Dividends since the maiden payment in 1895 come to £6,351,321 and more than £2,010,000 has been paid in tax. How much longer the mine can live after being worked on this scale depends very largely on the costs factor. Some amelioration of the position in this respect would probably set Kleinfontein on the road for another ten years. Any material worsening could bring the profitable life down to only a year or two. The company has the advantage of a reasonably modest capital amounting to £1,735,000 in £1 shares, so that when the mine eventually closes there could be quite a sizeable "break-up" distribution from the cleaning-up operations and disposal of the assets which include the mine's own power station.

Meanwhile, earnings in the first quarter of 1956 were still running at a rate equal to close on 6d. per share per annum. The company should thus be able to remain in the dividend list this year.



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East Rand Consolidated Limited

AS a preliminary to asking shareholders of East Rand Consolidated for their sanction to effect the long-expected reduction in capital, the book values of various assets shown in the end-1954 balance-sheet were written down substantially. Mineral rights, which a year earlier had been carried in the books at £269,694, were reduced to £53,000 and the nominal value of £2 was placed on prospecting and option contracts in the O.F.S. and Transvaal instead of the previous figure of £7,804. The item "participation in oil ventures" valued at £19,477 at end-1953 was also reduced to a nominal £2.

Mainly as a result of these changes, the debit balance of the profit and loss account rose from £788,493 to £1,127,932. As the company adopts the practice of deducting the debit balance carried forward from the sum of the issued capital and capital reserves, aggregating £1,740,054 on December 31, 1954, the equity of the parent was worth a net £600,000.

With the report and accounts for 1954 went proposals to reduce the authorised and issued capital from £1,500,000 in 6,000,000 stock units of 5s. to £600,000 in 6,000,000 units of 2s. by writing 3s. off each issued stock unit; another resolution proposed to convert the new stock units into shares without distinctive numbers, and a third resolution was designed to restore the authorised capital of the company to £1,500,000, thereby taking advantage of the regulations which enable this restoration to be made without the payment of duty. All these resolutions were passed at the annual meeting in September, 1955, and Court sanction was obtained a couple of months later.

One of the effects of the changes made in the balance-sheet is to reduce the total book value of the assets to £766,536, and as investments, quoted and unquoted, stood at £522,485, this item now accounts for two-thirds of the company's assets.

Roughly one-half of East Rand Consolidated's revenue of £48,262 in 1954 came from dividends and interest, the remainder being derived from profits from the sale of investments and to a smaller extent from sundry items. This is encouraging for dividends at £25,214 have virtually retained the advance made in the previous year, and the expansion in sundry revenue has also been held. At the same time investment sale profits have risen from £15,882 to £19,736. When the 1955 accounts are available, dividend income is likely to be larger, since Falcon Mines in which East Rand Consolidated is interested, paid 17½ per cent in 1955, against only 7½ per cent in 1954.

The 1954 accounts were also encouraging because they disclosed that the loss on mining operations was much less than in the previous year, and hence the net profit was able to expand from £25,013 to £35,110. A continuation of profits on this scale would bring a dividend nearer.

The company owns mineral rights over 2,627 morgen in the East Rand-Heidelberg district of the Transvaal, 12,663 morgen in the Lydenburg and Belfast districts, and 276 gold-mining claims in the O.F.S. and has share interests in the following companies in the Far Eastern Rand.

WITWATERSRAND NIGEL LIMITED

At the Southern extremity of the South East Rand lies a large area, comprising 14,739 claims, in which Witwatersrand Nigel is interested.

One of the shafts serving the Houtpoort section is now nearing the end of its effective life, as it has been found that it will not be economic much longer to mine the lower levels of this section from the No. 1 shaft. It has therefore been decided to sink another shaft, to be called the No. 3 shaft, at an estimated cost of £300,000. Most of the capital expenditure, amounting to £101,609 in 1954-55, was incurred almost entirely on work in connection with this new shaft. It is hoped that the shaft, which will be approximately 14,000 feet north-west of the No. 1 shaft, will be completed in the second half of 1957. Last October the chairman expressed the hope that this forecast would still be justified despite delays on the part of certain contractors.

During 1954-55, the percentage of development estimated to be payable on the Houtpoort section rose considerably above the disappointing levels of the previous year, but values were slightly lower. Present indications on the lower levels in this part of the mine are that the pay shoot is probably not as wide as higher up, but it is too early to judge whether this is any more than a temporary condition.

Once again, a larger tonnage has been put through the mill —214,000 in 1954-55 as compared with 207,600 tons a year earlier—the price obtained for gold from each ton milled, being the same as in 1953-54. In addition, working costs were cut by 3d. per ton to 46s. and hence working profits per ton rose by 4d. to 9s. 10d.

Year to June 30	*Milled tons* (000)	*Per ton milled Grade* (*dwt.*)	*Cost** *s.*	*d.*	*Working Profit* £	*Capital Expend.* £	*Ore Reserves Tons* (000)	*Grade* (*dwt.*)
1955	214.0	4.451	46	0	105,639	101,607	779	4.6
1954	207.6	4.479	46	3	98,764	37,789	746	4.6
1953	202.4	4.514	47	8	100,041	33,495	729	4.4
1952	136.0	4.807	58	7	22,258	120,665	690	4.4

* Including development.

As a result of these changes, working profits expanded to £105,639 (£98,764) and after allowing for enhanced receipts from interest and rents the company's disposable balance was £113,818. The sum of £978 was allocated to meet an increase in the silicosis liability, £30 was taken for taxation, £49,842 for the payment of the year's dividend of 5 per cent and £2,492 for directors' additional remuneration, leaving a balance of £60,476. At the end of last June, current assets exceeded current liabilities by the comfortable margin of almost exactly £97,000 and the board last November were therefore able to repeat the declared dividend of 5 per cent as paid in the two previous years.

Ore reserves at June 30, 1955, were 33,000 tons higher at 779,000 tons, the value being unchanged at 4.6 dwt.

SPAARWATER GOLD MINING COMPANY LIMITED

This company was formed in 1934 to explore a large lease area comprising 5,012 claims on the south-west boundary of the Sub-Nigel Mine. This it has been proceeding to do, with the exception of the war years, by means of underground development. It has in the event been found that the area is traversed by a series of ore shoots with intervening barren stretches. In 1947, in order to assist in financing the cost of this exploratory development, a mill was erected with a monthly throughput of approximately 10,000 tons of ore.

Exploration of recent years has been concentrated in the neighbourhood of the zones where payable ore was considered as most likely to be found, and disclosures have been favourable in the pay shoot zones close to the boundary of the Sub-Nigel mine and also in the zone at the far western extremity of the 37 West Haulage which is being driven across the lease area to the western boundary.

Revenue from mining and milling has enabled the company to continue exploration of the lease area without making serious inroads into its cash resources and, as a result of recent disclosures, it has been posible to build up the ore reserve to 208,000 tons, which has introduced a greater stability in the outlook for production, and there seems, therefore, to be a reasonable prospect for completing the examination of the lease area without raising new funds for this purpose. Working profits are being maintained at a nominal level as a result of this policy.

Future prospects for the property lie wholly in the possibility of discovering additional payable ore and underground development is continuing with this object in view.

WEST VLAKFONTEIN GOLD MINING CO. LTD.

This company, having surrendered the bulk of its lease area, has been in the process of disposing of its saleable plant. By a Circular Letter dated January 10, 1956, it was reported that realized net cash assets totalled approximately £225,000 net. The company's new policy is to utilize these resources in the field of investment and by embarking on participations in ventures of a promising nature. As a first step, a non-contributory interest has been taken in the new Far East Rand area entitling the company to 12½ per cent of the net vendor consideration and 12½ per cent in the subscription and/or underwriting rights which may accrue as a result of the turning to account of certain mineral option and prospecting contracts over farms aggregating approximately 40,000 acres in the Witbank, Bethal and Delmas Districts of the Transvaal.

Your company retains a major shareholding in the West Vlakfontein Gold Mining Co. Ltd.

Anglo-French Exploration Company Limited

AS the majority of its funds were invested in gold mining companies located on the Far West Rand and in the Orange Free State, Anglo-French Exploration Company may justifiably be regarded as a growth stock.

Yet, attractive as the future for these holdings may be, Anglo-French's interests also embrace the fast expanding oil and copper industries. Moreover, in recognition of the growing industrial importance of platinum, the Company has recently extended its interests to this sphere. A particular merit of Anglo-French's portfolio is that about 97 per cent. of investments by value have a market quotation.

In order to provide funds for future investment rights, and to strengthen its cash resources, the company made an issue of 100,000 shares for cash at par during 1955. This raised the issued ordinary capital to £900,000 from £800,000 in ordinary stock units of £1.

The classification of the company's investments in recent years, based on the valuation at December 31, was :—

Year	*Gold**	*Oil*	*Copper†*	*Coal*	*Tin*	*Platinum*	*Other*
	%	%	%	%	%	%	%
1955	52.7	18.8	13.6	7.4	3.9	2.5	1.1
1954	54.9	17.6	12.7	6.3	6.7	—	1.8
1953	63.0	13.7	8.0	7.0	8.0	—	0.3

* Including holding companies which have substantial interests in gold mining companies.
† Refers to holdings in copper, lead and zinc.

Apart from its quoted investments shown on the 1955 balance sheet at £1,080,703—which had a market value at December 31 of £1,450,258, Anglo-French's assets include land holdings in Southern Rhodesia and township property in South Africa. Total assets at December 31, 1955 amounted to £1,100,941.

Amongst the company's investments in Far Western Rand Gold Mines are holdings in the established and dividend paying properties of West Driefontein and Venterspost. Also included is Doornfontein the new gold/uranium mine. A participation in West Witwatersrand Areas greatly enhances the company's stake in this prosperous field. The company also has a small participation in a prospecting operation being carried out by Johannesburg Consolidated Investment on the Far West Rand.

Financial results for the last three years were as follows :—

Year to Dec. 31	*Total Revenue*	*Taxation*	*Net Profit*	*Dividends**	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955	137,277	59,056	45,509	45,281	NIL	5,705
1954	104,688	40,245	39,109	38,500	25,000	5,477
1953	98,515	39,841	33,320	33,000	NIL	29,868

* 1955—8¼ per cent. on issued capital £900,000. 1954—8¼ per cent. on £800,000. 1953—7½ per cent. on £800,000.

Interesting additions to O.F.S. securities during 1955 were two of that year's three new dividend payers; Presidents Brand and Steyn. Shares were previously held in Western Holdings which was the third company concerned. Other holdings in this field include Orange Free State Investment Trust, Harmony and Welkom. By way of subscription rights accruing through a stake in New Consolidated Free State Exploration, a valuable participation has been obtained in Free State Saaiplaas. Consolidated Gold Fields of South Africa, Vlakfontein and Durban Deep also figure in Anglo-French's gold portfolio.

Shareholdings in the expanding oil industry were represented by Attock Oil, Apex (Trinidad) Oilfields, British-Borneo Petroleum Syndicate and Ultramar. Interests in copper and other base metal producers were strengthened during 1955 by the addition of Bancroft Mines—the developing Northern Rhodesia copper property. Copper investments also included Nchanga, Rhodesian Anglo American and Rhodesian Selection Trust. Mount Isa and New Broken Hill Consolidated figured amongst lead-zinc holdings.

Amongst Anglo-French's tin investments — which were greatly decreased during the past year—were Malayan Tin Dredging, Southern Malayan Tin Dredging, Pengkalen and Anglo-Burma Tin. Holdings in the platinum industry were represented by Potgietersrust Platinums, while this comment equally applied to Apex Mines in respect of coal investments.

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The South West Africa Co. Ltd.

SOME three-quarters of The South West Africa Company's revenue was in the company's last financial year derived from the production of vanadium. As an essential by-product of vanadium mining, the company's lead output earns an important, if somewhat erratic, income. But owing to the low grade nature of its oxidized deposits, zinc mining falls into an entirely different category. Indeed, during the past three years production of this metal would not have been economic. Output was therefore suspended.

The South West Africa Company at present is operating three mines ; Abenab West, Berg Aukas and Brandberg West. In addition, a number of unquoted securities including 95,000 shares in the Tsumeb Corporation are held. Freehold rights over some 100,000 acres of land are also owned, together with exclusive prospecting rights over 3,000 square miles in Damaraland. The latter are being prospected by Tsumeb Exploration Company in which a 25 per cent interest is held.

The balance sheet as at June 30, 1955, showed total assets at £1,125,143 as compared with £1,155,314 in respect of the preceding year. Of this amount fixed assets totalled £640,747 and investments at the cost figure of £77,539. Current assets exceed current liabilities by about £130,000. As the investments are worth very much more than they cost, and as freehold land and mineral rights are accorded no balance sheet figure, the company's asset position is very much stronger than it appears.

MINING AND PROSPECTING

The Abenab West mine has up to now been important primarily for vanadium. Recent development in depth has, however, disclosed a massive sulphide lead-zinc orebody of primary origin. A plant to treat the ore from this deposit at an initial rate of 100 tons a day is being installed.

Another property, Berg Aukas, a zinc-vanadium producer, has recently been brought back into production.

Due partly to the smaller quantity of lead and lead-vanadium concentrates delivered during the past financial year and also to the lower grade of ore treated, proceeds from lead were only half those of the previous year. On the other hand, the improvement in demand for vanadium raised sales of this metal considerably.

An analysis of the ore sales accounts for the company's last three financial years shows :—

Year to June 30	*Lead* (Conc.)*	*Vanadium (Conc.)*	*Vanadium Acid and Slags†*	*Zinc (Conc.)*	*Tin/Tung (Conc.)*	*Total Sales*
	£	£	£	£	£	£
1955	216,878	—	746,526	—	121,243	1,084,647
1954	438,957	160,948	440,868	—	113,199	1,153,972
1953	216,761	138,640	882,539	—	73,937	1,311,877

* Lead ex-lead/vanadium Concentrates
† Fused vanadic acid and slags from treatment of concentrates

The addition of sundry receipts raised total revenue to £1,212,378 from £1,140,715. But greatly increased expenses reduced net profit to £56,959 from £72,470. A dividend of 2s. 6d. per 13s. 4d. share was paid on the issued capital of £354,538.

An analysis of the cost of producing the company's principal products shows :—

Year to June 30	*Mining Costs*	*Refining Costs*	*Shipment Costs**	*Prospecting*	*Admin. Costs†*	*Total Costs*
	£	£	£	£	£	£
1955	424,420	417,686	62,463	17,400	50,675	972,644
1954	391,048	253,819	104,726	27,277	47,095	823,965
1953	400,431	663,557	89,596	31,001	56,406	1,240,991

* Refers to freight on ore shipments and rail charges to Walvis Bay.
† Including headquarters and administrative expenses and local taxes.

In the absence of published ore reserve figures it is difficult to estimate the company's future life in terms of annual production.

The Chairman, in his Statement which accompanied the Directors' Report and Accounts recently issued, informed Shareholders that Treasury permission to transfer the control and management of the company to South West Africa had been refused, but that efforts to have this decision reviewed are being continued.

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Henderson's Transvaal Estates

COAL and cement production form the two main interests of Henderson's Transvaal Estates. The first of these is very much the larger of the two, and is carried out by a subsidiary company — Tweefontein United Collieries — one of South Africa's most important coal producers. A very substantial shareholding in Whites South African Portland Cement represents the company's valuable stake the latter industry. Both of these interests have considerable growth prospects.

Of lesser real importance, but of considerable potential value, are the land and mineral rights held by Mineral Holdings, another subsidiary of Henderson's. At the end of March, 1955, freehold totalling 14,798 morgen, mineral rights over 319,436 morgen, and concessions over a total of 355,681 morgen in Swaziland were held by this company. In its role as the group exploration company, Mineral Holdings has certain of these areas under constant investigation.

Henderson's also has a portfolio of securities particularly concerned with gold mining, and generally, with other South African enterprise. Useful revenue is derived from this source. Besides this, certain properties are owned which yield income by way of rent.

Year to March 31	*Coal* Profits*	*Divs. & Interest*	*Rents (Net)*	*Royalties etc.*	*Share dealing*	*Miscellaneous*
	£	£	£	£	£	£
1955	141,915	73,263	5,063	4,287	1,846	687
1954	176,219	68,204	3,562	1,894	1,161	673
1953	175,165	71,737	3,412	1,727	8,661	7,080†

* After working expenses including replacements, renewals and selling commission.

† Including £6,822 from sale of property.

DIVIDEND MAINTAINED FOR NINTH SUCCESSIVE YEAR

For the ninth successive year, distribution on Henderson's issued ordinary capital of £563,697 in ordinary stock units of 4s. was maintained at 15 per cent. Over the past twenty-five years dividends have followed a constantly increasing trend. In view of the progressive nature of the company's main interests, there seems reason to expect that this should continue.

Year to March 31	*Total Revenue*	*Taxation*	*Net Profit*	*Dividends*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955	227,061	70,950	78,462	48,599	37,519	171,992
1954	251,713	84,759	88,933	46,486	37,403	163,554
1953	267,782	103,706	94,224	46,486	37,351	171,392

Group consolidated balance sheet figures at March 31, 1955, showed a slight increase in total assets to £1,995,453 from £1,981,542 in respect of the preceding year. Quoted investments had a market value of £487,889 compared with a book value of £487,008. Unquoted securities and trade investments — of which Whites Portland Cement represented the greater proportion — shown on the balance sheet at £285,798 were valued by the directors at £318,000. Net liquid assets totalled £431,601 while capital and reserves indicated a break up value of some 10s. a share, or more than 2½ times the nominal value of the issued capital.

LARGE RESERVES PROVED AT TWEEFONTEIN

By establishing that reserves at Tweefontein United Collieries were adequate for future requirements, development work during the financial year ended December 31, 1954, was of considerable significance. Indeed, it resulted in the Board authorizing substantial expenditure on the renewal of existing plant, new equipment and housing. Difficulties in distribution of the collieries' full output due to shortage of railway trucks have been overcome to a large extent by arrangements made for haulage of a considerable tonnage by road.

During the financial year ended December 31, 1954, Tweefontein's coal sales rose to 1,315,496 tons from 1,279,529 tons during the preceding year. But due mainly to increases in costs, and the failure of Transvaal Coal Owners' Association to secure a rise in the fixed government coal selling price, profits fell to £142,000 from £176,200. After maintaining its dividend of 10 per cent on both the ordinary and cumulative participating preference shares which absorbed £58,375, Tweefontein's carry forward was £17,711.

Previously development and mining operations have been mainly concentrated on No. 2 seam, which underlies large areas of both the Waterpan and Tweefontein sections. But recently, underground prospecting work has disclosed No. 1 seam both at the Waterpan Shaft area and in a section lying west of Tweefontein West Shaft. Until No. 1 seam is more fully opened up, however, No. 2 is likely to continue as the main producer.

A further increase in sales output of 36,796 tons to 1,352,292 tons was achieved by Tweefontein during the twelve months ended December 31, 1955. A more constant supply of trucks was maintained by the railways throughout the year, but shortages were nevertheless experienced from time to time. The position was, however, very materially assisted by the substantial tonnage of coal hauled by road. Amounting to no less than 324,633 tons, this represented 24 per cent. of total tonnage sold. Due to a higher taxation liability net profits after tax earned by Tweefontein during 1955 declined to £81,237 from £86,443. But dividends were maintained at 10 per cent. on both the ordinary and preference shares. After a transfer of £19,262, compared with £40,000, to general reserve, carry forward rose to £21,311.

ANOTHER SUCCESSFUL YEAR FOR WHITES

The twelve months ended November 30, 1954, witnessed another successful year for Whites South African Portland Cement Co. Total deliveries amounted to 520,000 tons as compared with 519,000 in respect of the previous year. Profits before tax were up by approximately £169,500 and after deduction of tax showed the striking increase to £509,000 from £390,000. After transferring £275,000 to reserve and paying an 11½ per cent. dividend, as compared with only 10 per cent., the carry forward was increased by £13,000.

Henderson's very substantial unquoted holding in Whites represents its major non-subsidiary interest. Indeed, with the enormous unsatisfied demand for cement in South Africa, it seems likely that the great strides made in recent years by this progressive company will continue. Some years ago, the original old Whites South African Portland Company was re-organized and expanded under the auspices of the Associated Portland Cement and the British Portland Cement Manufacturers, who became shareholders. At that time a new factory — the largest and most modern in the Union — was constructed at Lichtenburg on the site of a vast and rich deposit of limestone. During the past financial year a total of 378,000 tons of cement came from Lichtenburg and 142,000 from the old Whites factory.

MINERAL HOLDINGS : BETHAL AND OTHER INTERESTS

A great deal of topical interest attaches to the activities of Mineral Holdings which owns rights over a large area in the Bethal district of the Far Eastern Rand which have been included in prospecting option agreements with two of the principal mining finance houses. In this vicinity one new mine has recently been floated and it is thought that some five to six new mines will eventually be established in the district. What Henderson's future in this intriguing area might be is so far obscure. But several boreholes have been drilled on Mineral Holdings' properties and it is possible that the company will stand to receive a participation in any new mine to be established. This is, of course, a speculative matter, but any overall assessment of Henderson's would be incomplete unless some weight were given to this potentially valuable asset.

In order to decide which of Mineral Holdings' properties in South Africa or Swaziland are capable of economic development, a full scale review is being undertaken. It will subsequently be decided what to retain and what to sell. But as individual appraisals will take some considerable time, no quick results from this study should be anticipated.

VRYHEID PROJECT

In view of the strong demand for copper and its subsequent high price, it is a little disappointing that no further progress has been reported from Mineral Holdings' interesting property at Farm Vryheid 779 in the Northern Transvaal. Exploration in this area — which covers some 9,000 acres in the vicinity of the Dowe Tokwe Fault adjoining the well-known Messina (Transvaal) Development Company property — has proved the existence of copper deposits. Messina has stated its intention of investigating that part of the area lying in its own property and it must be assumed that the Henderson Group has decided to take no further action until the results of the adjacent prospecting operations are known.

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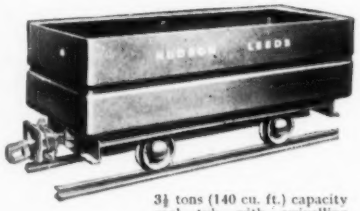

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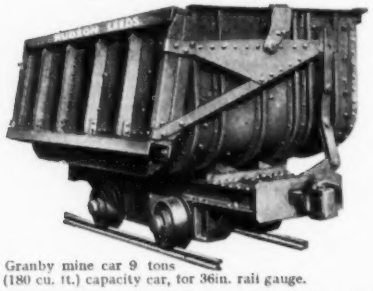

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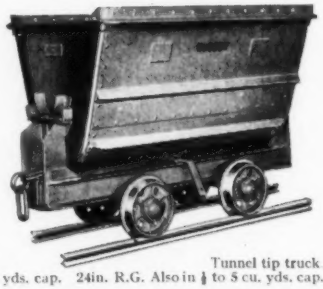

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Messina (Transvaal) Development Company Limited

THE progress and expansion of Messina (Transvaal) Development during the past year has again been an exceptional feature of the base-metal mining industry in Southern Africa.

Until comparatively recently one looked no further for an assessment of the company's position and prospects than the Messina Mine in the Northern Transvaal just south of the Southern Rhodesian border. Now, however, the company has appreciably strengthened its stake in the copper industry. This has been effected in part by bringing into production the small wholly owned Umkondo Mine in Southern Rhodesia but primarily by its holding of an 82 per cent interest in a larger copper project, Rhodesia Copper Ventures, the name of which has recently been changed to M.T.D. Mangula. Aside, too, from its extensive prospecting activities, the company owns a considerable iron ore deposit at Bukwe, Southern Rhodesia.

RECORD SMELTER PRODUCTION

To come to more detail, it needs to be recorded that last year (September 30, 1955) operations at the Messina Mine in the Transvaal again resulted in the record smelter production of 14,202 tons compared with 13,688 tons in the previous year, a notable feature in the plant's operation being an advance from 96.2 to 96.8 per cent in the recovery of metal from concentrates.

Few mines anywhere have been able to defend themselves wholly against rising costs and during 1954/55 Messina was no exception, operating costs per l. ton of ore produced rising from 34s. 1d. to 34s. 8d. This advance was attributable almost entirely to the large increase in the number of European employees at work underground. In terms of metal, rather than ore, costs rose during the same period to an average of £114.56 per l.ton of recovered metal in ore produced as against £108.49 in the previous year.

The company, it should be emphasized, has been taking advantage of the strength of the price of copper by bringing to the mill as much low grade ore as can be expedient.

The technical position of the mines contributing towards operations in the Transvaal—Harper, Campbell, Messina and Artonvilla—appears to have been maintained. At the Harper, it is true, development on the 35th and 37th levels at the end of the year had failed to locate the downward extension of the large rich orebodies encountered on the higher levels. Here, the technical management is assuming that lateral displacement of the mineralized channels, as experienced on some upper levels in the past, may have recurred and an exploratory campaign consisting of long driving and regular diamond drilling has been put in hand. Development at Campbell was mainly confined to exploring known orebodies on the lower levels of the mine and at the Messina Mine itself major development is following the strike of the Messina fault with extensive drilling on the 24th level. Artonvilla ore reserves have satisfactorily increased, largely owing to appreciable increases in the size of blocked out ore on the 300 ft. and 875 ft. leve's on the Frost and Emery lodes respectively. Taking the four sections together, total ore reserves at September 30 last amounted to 4,800,000 tons averaging 1.94 per cent copper against 4,500,000 tons averaging 1.99 per cent a year earlier, a gain of nearly 3,000 tons in the copper content of the ore.

Year to Sept. 30	*Milled l. tons* (000)	*Grade** (% Cu.)	*Output l. tons*	*Cost per l. ton* £	*Ore Reserves tons* (000)	*Per cent* Cu.
1955	816.1	1.68	14,202	114.5	4,797.0	1.94
1954	806.8	1.73	13,688	108.5	4,520.4	1.99
1953	761.1	1.84	13,664	100.4	4,068.3	2.12

* Excluding jig tailing handled: 1955—70,795 l. tons containing 430.8 tons copper; 1954—71,736 l. tons containing 398.4 tons copper; 1953—63,375 l. tons containing 366.3 tons copper.

Meanwhile, the first of the Messina Company's newer ventures has already come into operation. The concentrator at Umkondo mine in Southern Rhodesia, which is wholly-owned by Messina, was completed last May and the first consignment of concentrates from Umkondo to the Messina smelter was delivered in June. The rate of smelting in the Messina furnace increased during the year to an average of 100.3 tons of concentrates per operating day, against an average of 97.5 tons in the previous year, and of the total charged to the furnace during the period 1,019 tons containing 349 tons of metal came from Umkondo. Since metal production from this new mine is expected to reach 2,000 tons annually, a further increase in the proportion of Umkondo material used in the smelter is probable during the current year. Total reserves of the Umkondo orebody amounted to 324,000 tons last September averaging 3.73 per cent copper for a total metal content of just over 12,000 tons.

The Messina consolidated gross revenue in 1954/55 amounted to £3,776,000 against £3,354,000 in the previous year, profits for the year after taxation being £1,535,000 compared with £1,383,000. At first sight, this may not have been an increase measuring up to some quarters' expectation. Taxation naturally absorbed more and in addition the company was called upon to meet a liability of £103,000 under the South African Silicosis Act, an item which did not occur in the previous year. Moreover, there were non-recurring new issue expenses of £83,000 to be met out of the net balance and in the previous year the total available for distribution was enhanced by windfalls of £252,000 in respect of a provision for contingencies, written back, and profits on the realisation of investments. The company, however, was able to increase the total distribution to 19s. per 5s. stock unit compared with the total of 18s. 6d. per unit in 1953/54.

Year to Sept. 30	*Total Revenue* £	*Taxation* £	*Net Profit* £	*Dividends* £	*To Reserve* £	*Carry Forward* £
1955	3,776,174	578,572	1,534,781	1,254,000	200,000	42,131
1954	3,353,907	523,962	1,382,676*	1,202,500	400,000	44,078
1953	3,451,990	578,290	1,538,796	1,300,000	90,000†	11,414

† Excluding £150,000 provision for contingencies.
* Excluding £150,000 provided for contingencies written back, and £102,488 profit on realization of investments.

But the outlook for Messina cannot, of course, be left at that. Rhodesia Copper Ventures (now known as M.T.D. Mangula), in which Messina holds a controlling 82 per cent equity interest, is continuing to progress towards the goal of production in 1959. The Mangula operation in Southern Rhodesia consists primarily of exploiting two sections—the Molly and Silverside—and for the moment attention is being concentrated on Molly. Molly ore reserves have been estimated at 16,000,000 tons averaging 1.60 per cent. Cu. above the 1,600 ft. level horizon. These figures include partial development on the 185 ft. and 485 ft. levels. No account has been taken of the Silverside reserves which, though of higher grade, consist primarily of oxidic ore. During the past year underground operations at Molly have included the retimbering of the shaft to the 485 ft. level and the installation of a new head-gear and hoist. It is the intention to sink this shaft to 635 ft. so as to be able to carry out underground development without waiting for the completion of the Main shaft. Work has already begun on this six compartment, rectangular shaft, the headgear for which is in position.

Concomitant activities always to be associated with the laying out and bringing to production of a new mine have progressed according to schedule and there seems no reason to believe that the production target date of 1959 should not be reached easily. This operation aims at an output of 2,000 l. tons of ore per day and an initial metal production of 10,000 tons a year. It has already been forecast that costs are not likely to exceed £120 per l. ton of copper, which would be not far out of line with the figure experienced by Messina itself in the Transvaal. By the end of the present decade there is thus the prospect, assuming the metal price to be maintained at anything above, say, £300 per ton, of a doubling at least of the Messina Company's total earnings.

MESSINA'S BUKWE IRON ORE DEPOSIT

Yet a further, and altogether different, venture on which Messina (Transvaal) appears likely to embark concerns the Bukwe iron ore deposits which lie about 140 miles away from the existing State steel works at Que Que in Southern Rhodesia. The company has recently exercised its option over these deposits, where further exploration during the past year by diamond drilling and development has proved the high-grade haematite ore exposed on the surface to persist both in quality and quantity to a considerable depth. The ore has been reported on favourably as to its suitability for pig-iron manufacture, the production of which on a large scale for both local and overseas consumption would, it is thought, prove highly profitable. The question has arisen of combining the Rhodesian Iron and Steel Commission and enlarging and modernizing the Government's steel works at Que Que instead of establishing a separate works at Bukwe. It is thought possible that United Kingdom steel interests might become interested in this project.

Rhodesian Corporation Ltd.

THE satisfactory continued expansion in both income and assets of Rhodesian Corporation Limited during recent years reflects the part that such companies are playing in the active development of the Rhodesias.

Rhodesian Corporation has a large stake in the Southern Rhodesian farming, land and real estate businesses, while inter alia it has played a large part in the development of indigenous resources of that country as evidenced by its substantial shareholdings in Rhodesian Brick and Potteries and Falcon Mines both of which companies are now well established dividend payers.

The Corporation also owns and operates two small gold mining properties in that country, together with a township in the Union of South Africa.

As well as the foregoing interests a large portfolio of investments is held, which is a source of income both by way of dividends and profitable share realisations.

Rhodesian Corporation's total assets at September 30, 1955, amounted to £1,225,482 against £1,201,932 previously. Quoted investments shown at £554,619 had a market value of £638,214 while net liquid assets totalled £154,710.

Year to Sept. 30	*Dividends Received etc.*	*Farm and Estate Rev.*	*Share dealing*	*Mining Revenue*	*Sundry Rev.*	*Property Sales*
	£	£	£	£	£	£
1955	59,915	30,264	18,638	13,899	6,743	1,253
1954	37,867	24,833	20,944	11,595	4,689	14,381
1953	28,063	18,610	5,717	3,313	4,413	2,576

A notable event which occurred since the end of the last financial year was the acquisition of Nigerian Consolidated Mines, an investment company whose portfolio includes a holding of mining shares. Payment for Nigerian Consolidated was effected by the allotment of 618,550 Rhodesian Corporation shares, thus raising the Corporation's issued capital to £1,080,870 in stock units of 3s. 4d.

Against the favourable background of the rapidly expanding Central African Federation economy and the demand for housing, Rhodesian Brick and Potteries would appear to have an extremely bright future.

Profits earned by this young and progressive company during the year ended September 30, 1955, expanded to £123,696 from £81,377 during the previous year. A sum of £40,000 was placed to general reserve bringing total funds in this account to £120,000. A maiden dividend of 7½ per cent was paid on September 7, 1955.

Since a review of Falcon Mines appears in the adjacent column, nothing further need be said about this property except that it has become a valuable dividend earner for the Corporation.

The expanding revenue and distributed profits of Rhodesian Corporation are clearly illustrated in the following table :—

Year to Sept. 30	*Total Revenue*	*Taxation*	*Net Profit*	*Dividends**	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955	130,712	4,060	79,929	60,668	10,000	36,176†
1954	114,309	4,089	70,752	53,778	15,000	31,076
1953	62,692	1,592	25,268	39,722	Nil	29,102

* 1955—2½ per cent interim paid on issued capital of £977,778 and final of 7½ per cent on £1,080,869. 13. 4d.
1954—10 per cent on £977,778. 1953—7½ per cent on £977,778.

† After writing off £4,161 for mining development.

Most important amongst the company's extensive land holdings are those which adjoin the municipal boundaries of Bulawayo and Salisbury, although little can be done about developing these potentially valuable assets into townships until the Government have taken the decision to provide adequate water supplies.

On its Kent and Trelawney Estates — which together cover nearly 27,000 acres — the Corporation is engaged in general agriculture and livestock breeding. Much attention has been paid to the introduction of modern methods of cultivation and dams have been constructed in order to provide adequately against drought. A useful participation has also been taken in the tobacco growing industry.

Rhodesian Corporation's direct gold mining operations are carried out at its Fred and Redwing Mines which provides a useful contribution to the Group revenue.

Falcon Mines Ltd.

AFTER a long period during which profits were continuously ploughed back to finance an expansion of operations at Falcon Mines, the company can now look forward to an era during which the benefits of past austerity should be reaped. Moreover, with its new and promising Dalny Mine opening up well at depth further rises in output may be anticipated. While this represents the natural corollary of recent encouraging discoveries, it is particularly welcome owing to the decline in life potential at Falcon's other two small mines Sunace and Bay Horse.

In addition to its three producing mines, Falcon owns 600 M'tuga Copper claims in Northern Rhodesia. These were tributed during the past financial year ended September 30, 1955, to a third party on a royalty basis. Tribute arrangements over the Company's Falcon Mine were terminated on July 31, 1955.

The company's balance sheet at September 30, 1955, showed total assets at £1,322,380 compared with £1,250,666 at the end of the preceding year. Of this figure fixed assets including all mining claims, plant machinery, etc., totalled £1,187,151 against £1,158,941. Current assets were shown to exceed current liabilities by £22,610.

A summary of the good results obtained at Dalny during the past financial year are shown in the table below. These figures do not, however, include statistics in respect of Sunace and Bay Horse Mines.

Year to Sept. 30	*Tons Milled*	*Per ton milled Grade*	*yield*	*cost **	*Devt. ftge.*	*Ore† Reserves*
	(000)	*dwt.*	*oz.*	*s. d.*	(000)	(000)
1955	162.6	3.39	27,568	30 0	5.8	457.0
1954	159.9	3.08	24,651	27 5	6.3	548.5
1953	142.0	2.47	17,535	27 2	7.6	565.6

* Includes development costs 1955—2s. 11d. 1954—3s. 0d. 1953—3s. 10d

† Value 4.3 dwts. over 103 inches. 1954—value 4.2 dwt. over 112 inches. 1953 — 4.5 dwts. over 116 inches.

Working profit earned by Bay Horse Mine advanced to £5,122 from £3,262. At Sunace working profits were £7,633 compared with £10,625. Tribute from Falcon Mine brought in £992 against £1,146. In addition a total of £35,854 was added to revenue in respect of stockpiled concentrates retreated. But as this stockpile has now been completely dealt with no further revenue will accrue from this source. The following table shows the group profit and loss position for the year ended September 30, 1955.

Year to Sept. 30	*Total Revenue*	*Taxation*	*Net Profit*	*Dividend*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955	155,783*	Nil	142,761	79,433	Nil	23,518†
1954	127,049	Nil	116,963	45,390	75,000	19,408
1953	72,700	Nil	62,769	Nil	50,000	22,835

* Includes net revenue of £35,854 from re-treating stockpiled concentrates. 1954 — £21,417.

† After £10,000 written off unquoted shares.

Dividends on the company's issued ordinary capital of £453,903 in shares of 5s. totalled 17½ per cent compared with the previous year's distribution of 10 per cent.

Since the end of the past financial year some development results have been announced from the Dalny Mine which augur well for higher gold recoveries and a future expansion of output. Working from the Rix shaft which has been sunk to below the 13th level with the object of opening up the mine at depth, the central orebody has been intersected in one crosscut and three boreholes covering a strike length of 155 ft. The average reduced value of these intersections was 4.5 dwt. over 100 in. In view of the fact that these exposures were five levels below the mine's lowest stoping, and three levels below the lowest previous development on the 10th level, the results are most encouraging. Besides this, overall development at Dalny has been excellent. Values obtained from 2,715 ft. sampled have averaged 7.4 dwts. over 64 in. with payability running at 57 per cent.

During the first six months of Falcon Mines current financial year ending on September 30, 1956, the three mines crushed a total of 113,315 tons against 102,803 tons in the previous corresponding period. Working profits of £58,492 compared with £61,507 (excluding £23,215 profit on retreatment of concentrates). So far an interim of 7½ per cent (same) has been declared.

London & Rhodesian Mining and Land Co. Ltd.

IN past years the London and Rhodesian Mining and Land Company has shown no particular tendency to favour predominantly any of its three traditional interests, which lie in mining, ranching and real estate. There has recently, however, been some indication that the company is slowly moving towards a greater participation in, and an expansion of ancillary services to, the mining industry.

When viewed against the background of rapidly expanding economic conditions in the new Central African Federation, mining, land and real estate all have impressive growth possibilities. But if immediate return is regarded as being more important than the prospect of long-term capital appreciation, higher profit margins offered by mining provide a good explanation for the altered trend.

From the following table which segregates Lonrho's group income into individual items, it can be seen that direct mining revenue has undergone a sharp expansion in the past year or so. Besides this, earnings from secretarial and engineering services — mainly to mining companies — have made a very considerable advance. Dividends, again mainly representing receipts from mining companies, have reached higher levels in recent years. Share dealing has also brought in substantial profits but as Sir Joseph Ball, the chairman, has often stressed in the past, these must be expected to diminish as the company's portfolio becomes more stabilised.

Year to June 30	*Secretarial fees etc.*	*Dividends etc.*	*Mining operations*	*Share dealing*	*Ranching*	*Property Revenue**
	£	£	£	£	£	£
1955	96,629	52,448	48,005	30,752	36,239	22,749
1954	86,461	63,330	46,265	17,036	52,677	26,172
1953	70,607	52,665	29,237	Dr. 7	37,782	31,778

* Comprising revenues £7,994 and sales £14,755. 1954 — £8,336 and £17,836 respectively. 1953 — £9,217 and £22,561 respectively.

SALES OF REAL ESTATE

A substantial, if somewhat erratic source of profit to Lonrho is that derived from sales of land holdings. Following the establishment of a general policy under which low-yielding areas are liquidated and funds released invested elsewhere, sales are effected as and when opportunities occur. The past financial year provided a good example of this and witnessed the disposal of land totalling 24,701 acres. Some idea of the size of total holdings may be gained from the fact that even after many such transactions the very substantial total of 912,871 acres remained. Two town properties were also sold, and since the end of the past financial year a further two stands in Bulawayo were disposed of for £125,000, which brought stand holdings down to 22 in number.

That it was considered justified to raise the dividend on Lonrho's one class issued ordinary capital of £1,000,000 in stock units of 5s. to 10 per cent. for the past year was a promising portent for the future. An excellent record has been maintained in past years, dividends from 1940 to 1951 having been held at a minimum of 5 per cent. From 1951 this was increased to 6 per cent. and subsequently to 7½ per cent. in 1954.

Year to June 30	*Total Revenue**	*Taxation*	*Net Profit*	*Dividend*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955	282,135	69,861	60,995	55,663	3,511	50,375
1954	286,184	97,709	65,272	39,187	24,000	46,571
1953	222,062	46,547	51,036	29,925	20,000	46,231

* After mining claims expenditure written off £4,687. 1954 — £5,757. 1953 — nil.

The group's quoted securities comprise holdings in South African gold and coal mines and finance houses, including Henderson's Transvaal Estates (reviewed on page 277). In Rhodesia, participations are held in the Cam and Motor Mine — the Federation's largest gold producer — and in Coronation Syndicate which operates with great success four smaller mines.

Lonrho has two subsidiary companies, The African Investment Trust, which provides management and secretarial services and handles a large investment portfolio, and Mazoe Consolidated Mines, which owns and operates gold mining properties in Southern Rhodesia.

CAM AND MOTOR'S HIGHER RESERVES

As forecast by the chairman, working profits (after depreciation) of the Cam and Motor Gold Mining Company during its financial year ended June 30, 1955 receded somewhat to £432,223 from £506,583. This was due to an expected decline in grade from the exceptionally high level of 1953-54. Nevertheless, the past year was most successful in more ways than one. A total of 289,750 tons was milled at a grade of 6.23 dwt. per ton, producing profits which enabled dividends of 40 per cent. to be maintained on an issued capital of £562,500 as recently increased from £468,750. On the technical side, most favourable underground results were obtained.

Development disclosures during the past year have considerably enhanced the company's outlook. In March 1953 it was decided that unless work was extended to areas below the 40th level, there would be a foreseeable limit to the life of the mine. With this in mind, a substantial capital programme was formulated involving the expenditure of £830,000. Owing, however, to good development results from above the 40th level, obtained during the past financial year, there is not now the same urgency to increase the depth of the mine. It has, therefore, been decided to complete the ventilation programme and push forward for the moment with work on known reefs in upper levels.

Reflecting the past year's work, ore reserves rose to 1,454,800 tons at 6.6 dwt. per ton from 1,380,800 tons at the same value for the previous year. At the present rate of production about six years' mill supply is assured. After forty years' operations this represents a remarkable achievement.

Operating results for nine months of the current financial year ending February 29, 1956, showed 69,950 fine ounces of gold recovered from 211,500 tons milled. Working profit for this period — before depreciation and other charges — amounting to £357,800. The company declared a dividend of 20 per cent last November and the next declaration is to be expected in May.

Cam and Motor owns the Pickstone mine which will probably declare its maiden operating results in May or June. Ore reserves as at June 30, 1955 were 237,100 tons at 6.2 dwt. per ton.

GOOD PROGRESS BY CORONATION SYNDICATE

Although Coronation Syndicate's mines are very much smaller than the Cam and Motor, Lonrho's interest in their operations is an important one. The Syndicate owns the Muriel, Arcturus, Tebekwe and Butterfly mines which collectively milled about 167,500 tons of ore during the year ended June 30, 1955. Working profits, after all expenses, rose to £127,269 from £95,176 and after taxation, dividends of 20 per cent. on the issued ordinary capital of £402,500 absorbed £80,500 as compared with £60,375 in 1954.

Published figures for the first nine months of the Syndicate's financial year ending June 30, 1956 have shown a total working profit (before depreciation and other charges) of £164,800. Although this figure includes an unusually large contribution from Tebekwe — due to mining remnants in the last quarter of 1955 containing very high grade ore — it must be regarded as very satisfactory. Having exhausted all payable underground ore, Tebekwe is now treating an old surface sands dump.

MAZOE CONSOLIDATED

Lonrho owns 94 per cent. of Mazoe Consolidated Mine's issued capital of £128,723 in £1 shares. This company was formed in 1953 to take over the Bucks and Connaught Mines which have now been combined into the Mazoe Mine. During the year ended June 30, 1955, profits earned after amortization and tax amounted to £9,911. Some encouraging development results were obtained during the year and ore reserves at the year end advanced to 133,300 tons at a value of 8.3 dwt. per ton.

RANCHING ENCOUNTERS DIFFICULTIES

The fact that Lonrho can earn only 3½ per cent. or about £25,000 net per annum on its invested capital in ranching of some £700,000 gives some idea of the difficulties bedevilling this part of its business. Although a small interest has been taken in the speculative venture of tobacco growing, Lonrho is predominantly concerned with rearing high-grade cattle. These at present total over 30,000 head, on the company's two ranches, Wiltshire and Lochard.

While it has been emphasised that there is, at present, no intention of abandoning ranching, low prices paid by the Cold Storage Commission of Southern Rhodesia for high-grade beef render the present state of affairs most unsatisfactory. A Cattle Marketing Commission, appointed recently, has just issued its report and the future success of ranching activities of Lonrho and other large producers must greatly depend on the action which the Government now decides to take in regard to beef prices in the Federation.

The British South Africa Company

FEW investors who buy the 15s. stock units of the British South Africa company, or Chartered as they are known in the mining markets, are probably looking as far forward as thirty years, that is to the year 1986. But the company itself has been doing this in very active fashion since 1950 when it finally bowed to the nationalistic trends of modern times and came to an agreement with the Northern Rhodesian Government whereby Chartered's ownership of the mineral rights in that territory, acquired from Lewanika, the paramount chief of the Barotse. This will be relinquished on October 1, 1986.

This agreement, arrived at five years ago, set Chartered finally on the path towards its new role of a mining investment and finance company, a path that had been first marked out by two preceding events, the sale of the Southern Rhodesian mineral rights in 1933 and the sale of the railway ownership in both Southern and Northern Rhodesia in 1947. The modern pattern has still plenty of time in which to reach its final form. This is one of the most favourable factors in the outlook. The replacement of an income from mineral royalties which amounted to over £10,000,000 last year, even after allowing for the 20 per cent thereof which goes to the Northern Rhodesian Government, is hardly a task which can be undertaken hurriedly.

Even so, by September 30, 1955, Chartered had amassed a portfolio of investments with a book value of £16,500,000 and a market value on March 15, 1956, of £39,000,000. These investments were split up as to 31.76 per cent in " other mining companies " consisting mainly of South African mining finance companies and mines in the Anglo American Corporation and Consolidated Gold Fields groups ; 21.05 per cent in " Rhodesian mining companies " including Rhodesian Anglo American and the copper producers themselves ; 19.12 per cent in " miscellaneous Rhodesian interests " which embrace commercial and manufacturing concerns together with a half interest in New Rhodesia Investments which itself has investments with a book value of over £4,000,000 ; 15.52 per cent in " subsidiary companies " consisting of an 81 per cent holding in the equity of Rhodesia Railways Trust (which has a widespread portfolio of investments including substantial interests in Canada and America) and the whole capital of Cecil Investments formed last year as a finance concern to handle some of Chartered's investments.

EXPANDING ROYALTY INCOME

In the year to September 30, 1955, Chartered's income from these investments amounted to £1,800,000 out of a total revenue of £12,400,000 and three quarters of the investment income stemmed from the Rhodesian mining investments. Mining royalties brought in £10,100,000 so, as may be seen, Chartered is still predominantly identified with the fortunes of the Rhodesian copper producing industry. No less than 96 per cent of the royalty income came from this metal of which 340,000 tons were produced in Northern Rhodesia in the twelve months to September 30, 1955, compared with 370,000 tons in the previous year. In the current period to next September this output may rise to around 384,000 tons given freedom from labour strikes and no serious coal shortages. This does not include potential production from the new Chibuluma mine which is starting up its concentrator this May and has a potential annual output of 16,000 tons of copper and 500,000 lbs. of cobalt. Mufulira is still in the course of expanding its output and the Kansanshi mine is due to start production, albeit on a minor scale, in the second half of 1956. At the beginning of 1957 Bancroft should come in with an annual production of nearly 45,000 tons, a rate which it is planned to double in 1960.

Chartered's fortunes thus look to be assured so far as the amount of copper is concerned. How far its income from this source can be maintained or expanded depends, however, on the price of the metal. Chartered's royalties are based on a sliding scale of which the essence is that when the metal price is £80 per ton and upwards the company is paid 5 per cent of the price plus 10 per cent of that part of the price which is over £80. In the year to last September the average value for royalty purposes was £289 against £210 in the preceding year. The royalty on £289 works out at £35.35 per ton of which Chartered would have got £28.28, the other £7.07 going to the Northern Rhodesian Government. Since the end of last September copper has been up to over £430 per ton so that Chartered's revenue for the current financial year will have got away to a bumper start.

Actually something of a complication was introduced into the basis for calculating Chartered's royalties from copper by the decision in May, 1955, of the Rhodesian Selection Trust group to sell its metal (from the Roan Antelope and Mufulira mines) at a price to be fixed from time to time instead of at prices linked with the fluctuations in copper quotations on the London Metal Exchange. Until recently this fixed price has been consistently, and often substantially, below the L.M.E. quotations. The R.S.T. group considered that the royalties should be based on their fixed quotation. Chartered, however, insisted on its contractual rights and the L.M.E. quotations continue to provide the basis for valuing copper for royalty purposes both for the R.S.T. group's production and that of the Rhodesian Anglo American group (Rhokana and Nchanga) which has throughout continued to use L.M.E. quotations for its sales.

At the time of writing the price of copper has fallen back to under £350 per ton and the impression has gained ground that given freedom from material interruptions of production by labour strikes the boom in the metal is over for the time being. Last year's stringency in copper supplies, in other words, is being replaced by growing production against a background of some diminution in demand both in Europe and America. This is not to say that a slump in the value of copper is round the corner. And for Chartered there is the higher production to be taken into account plus the fact that the company does not have to worry about the rising costs of producing the metal. At the annual meeting of the company in March, 1956, the president, Mr. C. Hely-Hutchinson, said that those who are pessimistic about the future of the copper price may be comforted to know that " a reliable observer " has avowed that in the view of the copper industry collectively the price of electrolytic copper is not likely to fall much below £240 per ton " in the foreseeable future ". On the basis of an annual production of only 400,000 tons at that price Chartered's net annual income from all sources, after tax calculated at the rates then ruling, " is not likely to be far short of £4,000,000 ". This would certainly be satisfactory enough. Chartered's net profit in 1953-54 was £3,300,000 and in 1954-55 £5,600,000.

INTENSIVE EXPLORATION ACTIVITIES

Meanwhile, in the course of the next thirty years Chartered is obviously going to be vitally interested in any expansion of metal production in Northern Rhodesia that may take place as a result of the intensive exploration activities that are now in progress throughout the territory. Chartered is itself taking part in these activities through, for instance, Chartered Exploration which has prospecting rights over about 100,000 square miles. This concern is under Anglo American Corporation auspices, but Chartered and Consolidated Gold Fields both have interests therein. Promising discoveries of pyrochlore have been made in the northern part of Northern Rhodesia.

How far flung other exploration projects are is shown by the following necessarily brief résumé thereof. The Rhodesian Selection Trust group is particularly prominent. Apart from Chibuluma which, as already mentioned, has now attained production, it has two other mines which are at the stage when a decision to proceed to production could be made during the next year or so. These are Baluba and Chambishi. As the chairman of Rhodesian Selection Trust has said, Baluba is an asset of great potential value and has been described as being possibly the greatest undeveloped source of cobalt in the world. Chambishi has proved some 25,000,000 tons or ore containing 3.46 per cent copper. Apart from these concerns R.S.T. has four prospecting companies which have exploration rights over large areas of ground and in which Chartered holds a 10 per cent interest. Chisangwa Mines cover an extensive area to the west and north-west of the present Copperbelt. Still further to the west a huge area is under prospecting licence to Mwinilunga Mines, while to the south of the Copperbelt another area is held by Kadola Mines. The fourth concern, Luapula Mines, has rights over a strip nearly 200 miles long running along the Belgian Congo border.

Last year the R.S.T. group, in addition, formed a company called Rhodesian Selection Trust Exploration, the main purpose of which was to investigate proposals which may lead to new mining enterprises in the Federation of Rhodesia as a whole. The Rio Tinto group is also very active in exploration work in Rhodesia and has now initiated a prospecting programme in an area of about 2,500 square miles in Northern Rhodesia between Broken Hill and the Loangwa river well to the south of the Copperbelt. Expenditure of some £150,000 is expected to be incurred over a period of three years. The mineral rights of this area are owned by the Rhodesia-Katanga company, but Chartered has a direct 15 per cent interest therein.

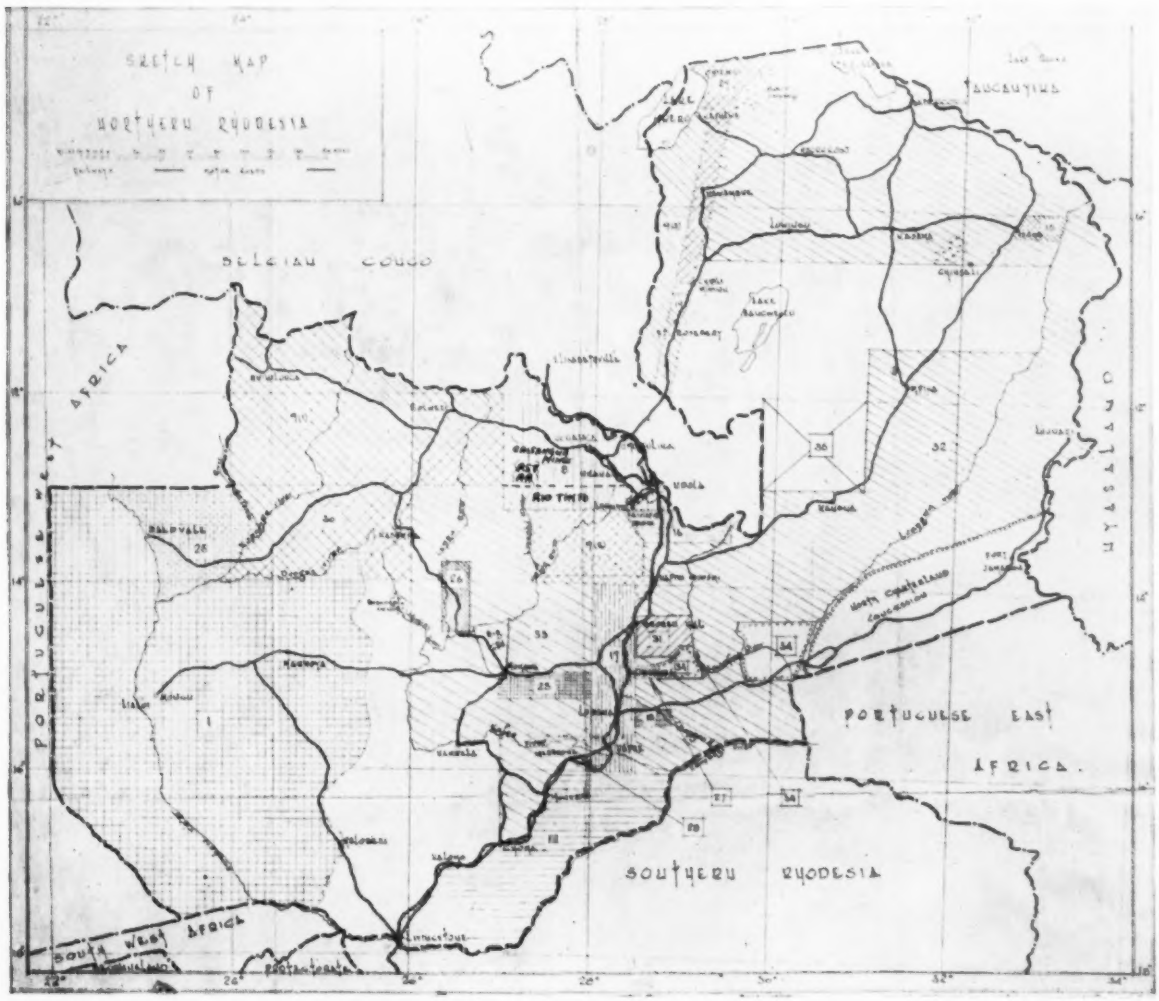
There are numerous other projects, but those summarized above are sufficient to indicate that Chartered's income from

mineral royalties could well benefit from new sources of supply.

One important question remains to be discussed. The stockholder in Chartered cannot be other than convinced that, providing he is prepared to take a thirty years' view, his interests are being well looked after. He will, of course, recognize that his fortunes are bound to fluctuate in accordance with the demand for and consequently with the price of copper. He may, however, be wondering to what extent the Board's long-term policy is likely to impinge on his participation by way of dividends in the current and future earnings of the company. In the year to September last, Chartered's gross profits were divided up as to 40 per cent to dividends (including the distributed profits tax on the payments), 32 per cent to taxes other than the distributed profits tax and 28 per cent was added to resources. Even so, the company's financial position at the end of last September may fairly be described as an attenuated one. Net liquid assets were little in excess of £1,000,000 against which there were commitments amounting to over £5,000,000 including £3,000,000 being advanced to the Bancroft company as part of the £5,000,000 loan facilities to that concern being jointly provided with Anglo American Corporation. As part of the arrangement Chartered has an option until June 30, 1958, to take up 1,000,000 Bancroft shares at 37s. 6d.

Chartered has also shown recently that, although it is gradually relinquishing the rights in Rhodesia won in the early pioneering days, it is still anxious to play its part in the expanding projects of the newly born Federation. Since the close of the last financial year the company has undertaken to lend the Federal Government over the next four or five years a total of £4,000,000 towards the financing of the big hydro-electric scheme in the Kariba Gorge. On this subject Mr. Hely-Hutchinson has said that such a contribution is fully justified not only because the scheme as a source of power will greatly benefit the Northern Rhodesian copper producing industry but because the company has " an inescapable obligation " to play its part in the development of the territories from which the greater part of its large revenues is drawn. That same obligation, the president added, may well involve the company in other similar commitments in future years. Nevertheless despite the existing liabilities of some £8,000,000 in excess of net cash resources Mr. Hely-Hutchinson thinks that they can be met without endangering maintenance of the dividend at the 1954-55 rate.

This dividend was 30 per cent on the capital of £13,140,753 which was doubled by last year's 100 per cent bonus issue. This distribution came out of available earnings which exceeded 73 per cent.



AREAS RESERVED AGAINST PROSPECTING, AUGUST 1955

1. Barotseland and Part of Balovale District.—No concessions.
8. Envelope Area.—Chisangwa Mines and Rio Tinto Areas.
9. (1) Mwinilunga Area.—R.S.T. group.
   (2) Kadola Area and Extension (20).—R.S.T. group.
   (3) Luapula Area and Extension (24).—R.S.T. group.
12. Zambesi Valley Area.—Chartered Exploration.
15. Ukombwa Hill Area. Isoka.—Chartered Exploration.
16. Rio Tinto Area 1.—R.T.
17. Rio Tinto Area 2.—R.T.
18. Chalimbana Area and Extensions. A. and B. (21 and 22).—Roan Antelope
19. Rhodesian Vanadium Corporation.
23. Rio Tinto Area 4.—R.T.
25. Balovale Area.—Chartered Exploration.
26. Lunea Area.—New Discovery Mining Corporation (Raymond Brooks).
27. Rio Tinto 5.—R.T.
29. Lake Mweru Area.—Weedon's Minerals.
30. Mwinilunga Extension Area.—R.S.T.
31. Broken Hill East Area.—Gypsum Industries.
32. Chartered Area No. 1.—Chartered Exploration.
33. Chartered Area No. 2.—Chartered Exploration.
34. Rhodesia Katanga Company's 3 Mineral Areas.
35. Chitambo Area.—De Beers.

Rhodesian Anglo American Limited

NO mining group has played a bigger part in the mineral development of Northern Rhodesia than the Anglo American Corporation of South Africa. Over the past twenty-five years or more vast capital sums have been required to bring the Copperbelt and other mining enterprises in the Rhodesias to their present high pitch of activity and in all this Anglo American's extensive role has been largely identified with the holding company, Rhodesian Anglo American, control of which is effectively held by Anglo American Corporation.

Rhodesian Anglo American was registered in this country in 1928 but control was transferred to Northern Rhodesia in 1951 and the company was re-incorporated in that country in 1954. After successive issues since the end of the war, the present authorized and issued capital is £6,500,000 in 10s. Ordinary stock units. The investment position now is that " Rhoanglo's " major assets are represented by its holdings in the operating companies in the Anglo American Corporation group. Rather more than a 52 per cent interest is held in Rhokana Corporation and what can be considered as effective control of Nchanga Consolidated Copper Mines is held through a 39 per cent direct and indirect holding in that undertaking. A 26.3 per cent direct and indirect interest in the younger Bancroft Mines is also held. Other smaller, though collectively important, interests are held in Mufulira Copper Mines, Rhodesia Copper Refineries, Rhodesia Broken Hill Development, Tanganyika Concessions and Wankie Colliery.

The last balance sheet (June 30, 1955) showed quoted investments at £11,160,000 in respect of subsidiary companies contrasted with a market valuation of nearly £72,000,000, additional quoted investments figuring at £2,000,000, having a market value of £4,467,000. There were also unquoted investments of £2,244,000 bringing the total book figure for the portfolio up to £15,430,000. Completing " Rhoanglo's " last balance sheet were current assets of £5,166,000, current liabilities of £4,528,000 and capital and revenue reserves amounting to £16,069,000.

The company's profits derive almost entirely from investment income and last year amounted to £5,500,000 compared with £5,100,000 in 1953-54. Net dividends payments amounting to 7s. 9d. per share absorbed just over £5,000,000.

This basic outline giving an essential picture of the present position of Rhoanglo itself should not disguise the fact that the company's fortunes must always be closely identified with these undertakings which, through their dividends, account for its major income. Any review of the parent company's prospects must therefore connote an appraisal of the position of the operating companies concerned.

RHOKANA A MINING-CUM-INVESTMENT COMPANY

Rhokana Corporation, formed originally to take over large prospecting rights in Northern Rhodesia and now one of the Copperbelt's major producers of the metal, will always be considered as Rhoanglo's most important interest. This is not only because Rhokana stands high as a revenue earner from copper but also because it has substantial investments in neighbouring undertakings which make it in fact a mining-cum-investment company.

During the year to June 30, 1955, Rhokana's production suffered from the African labour strike which lasted on the Copperbelt from January to March of that year. Ore milled was approximately 3,600,000 tons compared with the record of 4,100,000 in the previous year, output of the concentrator was 252,000 s. tons, against 274,000 tons, and smelter production on Rhokana account was 81,280 s. tons compared with 93,040 s. tons in 1953-54. The smelter continued to operate on Nchanga account and under this heading turned out 163,000 s. tons against 181,000 s. tons. Rhokana's total sales of blister and electrolytic copper during the year were 71,864 l. tons compared with 75,879 tons in the previous year, a decline which was minimized by the additional efforts of the European staff and some volunteer African labour during the strike period.

Meanwhile, cobalt production, though lower at 871 s.tons against 1,264 s.tons as the result of the strike, continues to provide a by-no-means negligible income. Two additional roasters are being put up to provide extra capacity required to handle lower-grade cobalt concentrates. Ore reserves contained in the three major orebodies mined by Rhokana — the Nkana North, NKana South and Mindola — increased last year by more than 4,000,000 tons to 100,400,000 tons, the average grade being 3.16 per cent copper against 3.20 per cent previously.

The overall position at Rhokana has been substantially enlarged in recent years by the gradual building up of investments in neighbouring undertakings which is already beginning to make itself forcibly shown in the corporation's accounts. Net operating profit in 1954-55 was £9,800,000 against £9,300,000. At the same time, there was an advance in investment income from £3,600,000 to £3,800,000, the net profit after taxation in the end being just over £10,000,000 against the £9,500,000 obtained in 1953-54.

Apart from the contribution towards increased profits, it is worth noting that the actual size of Rhokana's income from dividends and interest was £4,100,000 out of a total untaxed profit of nearly £13,700,000. This trend has been a feature of Rhokana's revenue picture to a persistently growing extent since the end of the war. The explanation in turn for this trend can be attributed largely to the growing success obtained by Nchanga Consolidated and Mufulira in which Rhokana holds 33.6 per cent and 26.5 per cent of the equities respectively. In addition, 50 per cent of the Ordinary share capital of Rhodesia Copper Refineries is held, besides 47.2 per cent of the issued capital of £5,076,400 of Bancroft Mines and £1,500,000 5 per cent, 1958-61 Notes in that undertaking. The stake held in this new Copperbelt mine will add considerably to Rhokana's investment income in the years ahead.

NCHANGA—THE LARGEST COPPERBELT PRODUCER

Northern Rhodesia's richest and largest copper producer is the younger Nchanga Consolidated which was registered in 1937 and started pilot plant production two years later. Production has expanded rapidly in post-war years and in the twelve months to March 31, 1955, output of finished copper amounted to 102,862 tons compared with 115,137 tons in the previous year, here again the effects of the African labour strike being apparent in the closing months of the company's financial year. In normal conditions it is probable that throughout the twelve months production would have surpassed the record 1953-54 level, as the tonnage of ore mined and milled was actually higher. On the other hand, the average recovery grade fell back to 5.82 per cent copper, contrasting with 6.33 per cent in the previous year. The company has been stepping up production by stages in recent years, the third stage, aiming at a minimum of 9,000 tons of copper monthly having been now comfortably exceeded so far as capacity is concerned.

In recent years the average grade of copper treated has been well above the average grade of the ore reserves because all mining has been from the unusually rich ore of the Nchanga West orebody. To achieve a more balanced rate of depletion of ore reserves it is now planned to mine simultaneously the relatively low grade ore of the Nchanga orebody in such a way that the overall production of copper will not be affected. The Nchanga orebody will be mined by large-scale open-cast methods and production should start in 1957. Total ore reserves amount to 142,800,000 tons averaging 4.73 per cent copper.

Although production was reduced during the closing months of 1954-55 owing to the strike, sales during this period were kept up almost to the normal rate out of the substantial pipeline stocks which existed. Since it was deemed necessary to re-establish the pipeline, sales to this extent were regarded as exceptional and in order to ensure that the effects of the strike were duly reflected in the accounts, the excess of production costs was wholly written off and the profit on " excess " sales, estimated at £875,000, placed to sales realisation reserve. Before allowance for this factor, profits after tax during 1954-55 were £10,200,000 against £8,800,000 in the previous year.

Bancroft Mines is the newest of the Copperbelt undertakings in the Anglo American group, being formed in 1953 to take over from Rhokana Corporation, a large area near the Belgian Congo border about fourteen miles north west of Nchanga. Original arrangements were for this new mine to produce 42,800 l. tons of copper annually as from the beginning of next year. This estimate still stands but it has also been decided to budget for a further expansion to 85,600 s. tons by 1960.

Recent work at Bancroft has of necessity inclined heavily towards such matters as housing and the erection of surface equipment. Meanwhile, the initial sinking programme in the No. 1 shaft area has been completed. Underground drilling on the 400 ft. and 600 ft. horizons has disclosed average values of 4.70 per cent copper which compares favourably with the original average value of the ore reserves in this area. The Bancroft property covers three known orebodies — Kirila Bomwe South (No. 1 shaft), Konkola (No. 2 shaft) and the Kirila Bomwe

North — total ore reserves in respect of all three orebodies as indicated by drilling being originally given as 92,000,000 tons averaging 3.67 per cent copper.

Bancroft has an authorized capital of £5,500,000 5s. units of which 5,076,400 have so far been issued. Additionally, Anglo American Corporation of South Africa and British South Africa Company are providing loan facilities up to £5,000,000 at 3½ per cent on amounts drawn repayable in cash up to the end of 1960. Until that time Bancroft has the right to ask Anglo and British South Africa Company to subscribe for or find subscribers for £5,000,000 6 per cent Notes having a 15-20 year life. In consideration Anglo and Chartered have been granted the option on 2,000,000 Bancroft shares at 37/6d. per share. There are also issued 3,000,000 5 per cent Notes repayable in four annual instalments starting at the end of 1958.

Although it may be taken that the mine is thus financed through to the start of production next year, it has been disclosed that original capital expenditure estimates have been exceeded and that since it has also been decided that the No. 1 shaft should be deepened during 1958 and 1959 at an approximate cost of £500,000 a further amount of something like £2,000,000 is estimated to be required after 1958 to bring the production rate up to 85,600 l. tons per annum. This may be found out of profits or by other means. However that may be, this big future copper producer, which should have a long life in front of it, will, by then, be earning substantial profits.

R.H.B. AND WANKIE COLLIERY

Among other " Anglo " group companies in Northern Rhodesia in which Rhoanglo is interested is Rhodesia Broken Hill Development, the lead-zinc producer which lies some 100 miles south of the Copperbelt. The fortunes of the Broken Hill undertaking necessarily fluctuate with movements in the metal prices. Zinc production has been gradually built up in recent years and in 1955 reached 27,882 l. tons, lead production being 16,050 l. tons. In early years the company also produced vanadium but this has not been so since 1952, although all vanadium-bearing ore has since been stockpiled. Meanwhile, the construction of a cadmium refining plant has been going forward. Net profits after tax recovered strongly on 1954 to £1,024,000 and during 1955 there has been a further advance to £1,154,000, dividends in both the past years totalling 1s. 3d. per share net.

The total issued capital of the Wankie Colliery amounts to £4,412,500 in 10s. shares of which 1,066,666 are held by Rhoanglo. The recent history of Wankie, on which the two Rhodesias are solely dependent for coal supplies, has been one of continuous expansion. Technical direction of Wankie was taken over by Anglo American Corporation in 1953 and the three collieries operated by the company just south of the Zambesi in Southern Rhodesia have now reached a joint capacity of over 5,000,000 tons of coal per year. The target set by the consulting engineers when they took control three years ago has thus now been virtually achieved. Whether production will yet awhile reach this level is another question, the transport position in the Rhodesias still being a deciding factor in this matter. Wankie's present concessions cover approximately 65 square miles containing an estimated 350,000,000 tons of extractable coal and further areas are held under option. On the basis of the existing three collieries and without taking account of any further operations which might be developed in the future, for which obvious scope exists, it can be said that Wankie has a comparatively long productive life in front of it. Profits have been rising in accordance with increased production and, after tax, amounted to £824,000 in the twelve months to August 31, 1955, compared with £424,000 in 1953-54.

What has so far been said of Rhoanglo has concerned the company's main interests in established operating mining undertakings. But in all the surge of activity which is now taking place in the Federation in the search for fresh mineral deposits the company is also taking a very prominent part. By their very nature, these activities can only be of long-term importance. But if it is thought, as may well be, that a further considerable expansion in the mineral industries of the Rhodesias is in store, then it follows that a big participation in this would be held by the Rhoanglo organization.

RHOANGLO'S CONTRIBUTION TO FEDERATION

In Southern Rhodesia last year a new company, Anglo American Rhodesian Development Corporation, was registered with an authorized capital of £2,000,000 in £1 shares, of which 5s. per share has been called. Rhoanglo subscribed for 50 per cent of the issued capital, the balance being taken by Anglo American Corporation of South Africa and associates. On its formation, the objects of Anglo American Rhodesian were described as including capital provision for the development of the natural resources of the Federation ; assistance where required for private undertakings and public works of value in the Federation ; and the raising of money in other parts of the world for these purposes. The Corporation was to be especially equipped to study the specific capital needs of the country and then to channel surplus investible funds of companies in the group to approved projects.

As a first step, Anglo American Rhodesian in July, 1955, made a successful issue in Holland of 2,500,000 4½ per cent 15-year Bonds at 98¼ per cent and in the following October it was announced that agreement had been reached between the Development Corporation and the Rhodesia Railways under the heads of which the Corporation is to purchase £5,000,000 of wagons and miscellaneous railway stock which, in turn, are to be hired to the railways for 25 years at hire charges on an agreed scale. This followed a loan of £1,000,000 by Rhoanglo itself at the end of 1954, the group as a whole having thus already helped the railways to the extent of £6,000,000. It has been estimated that the expansion of Rhodesian railway traffic is likely to be so great that a minimum investment of £28,000,000 over the next four years is going to be required for additional carrying and line capacity.

Yet another important contribution to the development of the Rhodesias is the decision of the Copper mining companies to assist in the financing of the Kariba Hydro-Electric Scheme. The companies of the two mining groups have agreed to provide £20,000,000 which will be used for urgent railway and other developments, including the Kariba project. The loan will be divided amongst the producing companies in proportion to their profits. In addition, during the period 1961-1967, all the copper mining companies then in production will accept a surcharge on the price of power from Kariba so as to provide £10,000,000 over seven years.

PROSPECTING ACTIVITIES

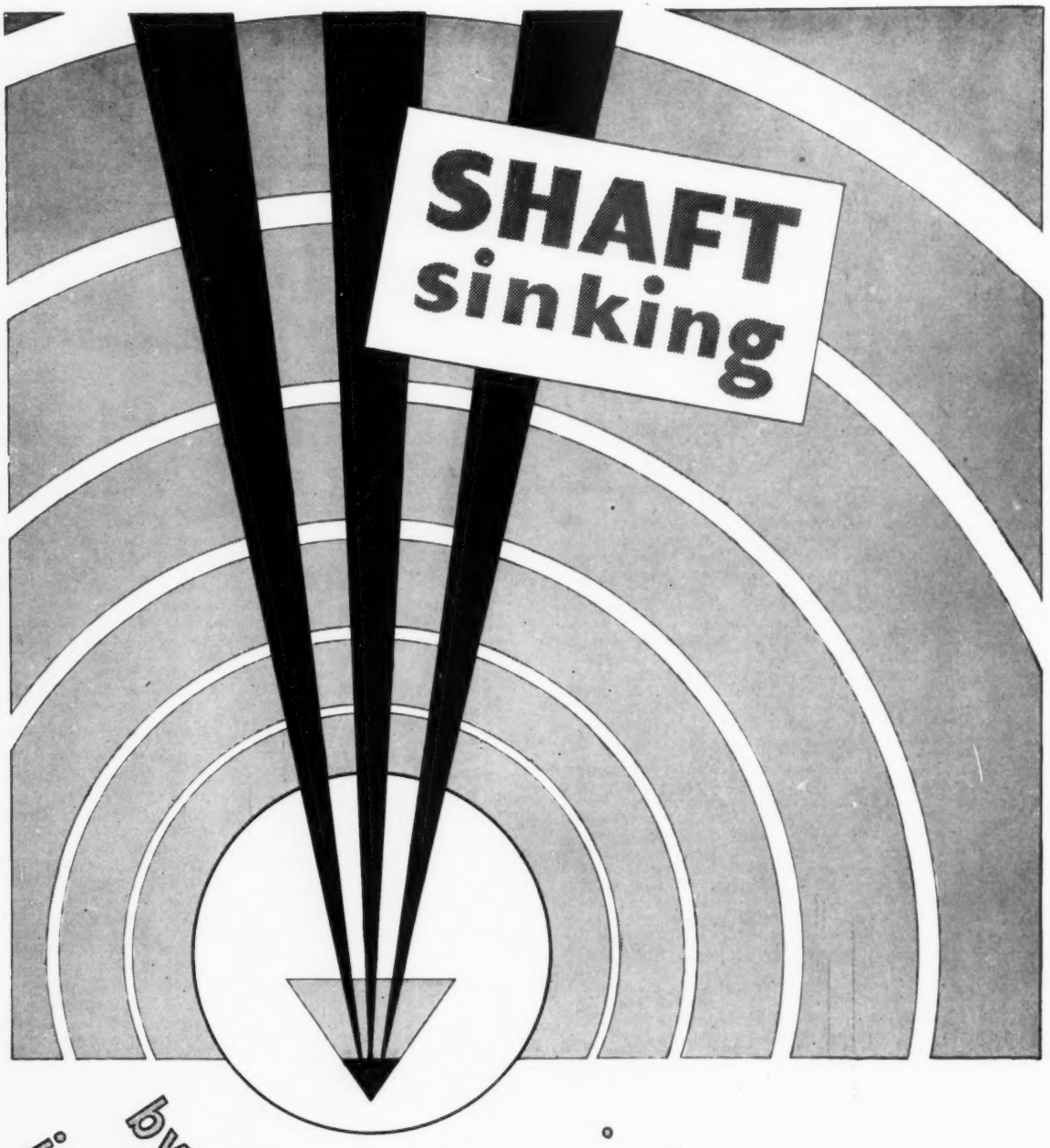
Other developments of a more specifically mining character have also enjoyed the substantial participation of Rhoanglo. A 30 per cent interest has been taken in Anglo American Rhodesian Mineral Exploration which was registered in Southern Rhodesia during 1955 with an authorized capital of £100,000 in 5s. shares. Nothing has yet emerged from this venture, which is undertaking the investigation of numerous mining propositions and carrying out prospecting operating in Southern Rhodesia and Nyasaland on behalf of the Anglo American group. Prospecting is necessarily a slow business, even with all the air-borne aids which are now in common use over such vast tracts as are involved in Africa.

Side by side with this development Rhoanglo has also taken a 20 per cent participation in the newly formed Chartered Exploration which was formed in 1955 by the British South Africa Company (Chartered) with an authorised capital of £1,000,000 in £1 shares. This prospecting undertaking, operating in Northern Rhodesia, may be likened to Anglo American Rhodesian Mineral in Southern Rhodesia and here again it will be a matter of awaiting whatever results current prospecting operations may produce. It is commonly felt that there are still considerable new mineral deposits to be found in the Federation and should this prove true Rhodesian Anglo American, besides Anglo American itself, has already done its best to see that its participation will not be negligible.

Emphasising the company's forward-looking views in terms of both mining and Rhodesian economic development generally, has come the latest news that the company jointly with Wankie Colliery is to finance a preliminary investigation into the possibilities of establishing an oil from coal industry in Southern Rhodesia. Both undertakings have an equal share in a company called Lubimbi Coal Areas which over the past six years has spent £245,000 on the acquisition of rights and on prospecting the potentialities of the Lubimbi coalfields in Southern Rhodesia.

As a preliminary move, the Lubimbi company proposes to spend a minimum of £30,000 more on investigating the whole question of setting up a large-scale petrol and allied chemical industry on the coalfield and assurances have been given by the Southern Rhodesian Government over questions of title sufficient to enable the company to go ahead with its experimental and pilot plans. If success attends the venture, it will be worth remembering that Rhoanglo will be interested to the direct extent of 50 per cent and further through its holding in Wankie Colliery.

In sum, the Rhoanglo position, representing as it does the main branch of the Anglo American group's great activities in the Federation, is reflecting not only the current high level of metal mining activity but also whatever future developments may take place in this field. Outside the less material ground of profit earning the company is coming to be increasingly seen as one which appreciates — as indeed others do — the growing responsibility in Federal, social and economic affairs which the big mining groups in the Rhodesias fairly can be expected to shoulder.



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Rhodesian Selection Trust Group

TO get a much better balance of Central African Federation and to draw the Copperbelt into a more real association with the surrounding territory is a paramount necessity if the Federation is to succeed. This is the long view. But in a territory which is only at the beginning of nationhood, and for a mining enterprise that may develop into the world's largest source of copper, the long view is the only possible one. For this reason the Rhodesian Selection Trust Group are, generally speaking, shaping their policies to obey what sociologists are fond of calling "The Law of the Situation," thereby explaining the Group's growing interest in developments in the Federation outside the realms of copper.

R.S.T. TAKES THE LONG VIEW

A superficial glance at the activities of the Rhodesian Selection Trust Group of companies reveals a paradox. The copper mining industry is booming—perhaps as never before. There is a high rate of output, a high price for the product, and a seemingly unquenchable and world-wide thirst for copper; Roan Antelope and Mufulira are producing at capacity rates, Chibuluma is raising ore, and Ndola refinery is in hand. It might seem that in these circumstances R.S.T. would be devoting its energies entirely to production, exploration and development work. It is extremely active, of course, in all these fields. But what is remarkable is the time being devoted by R.S.T. to developments outside of copper.

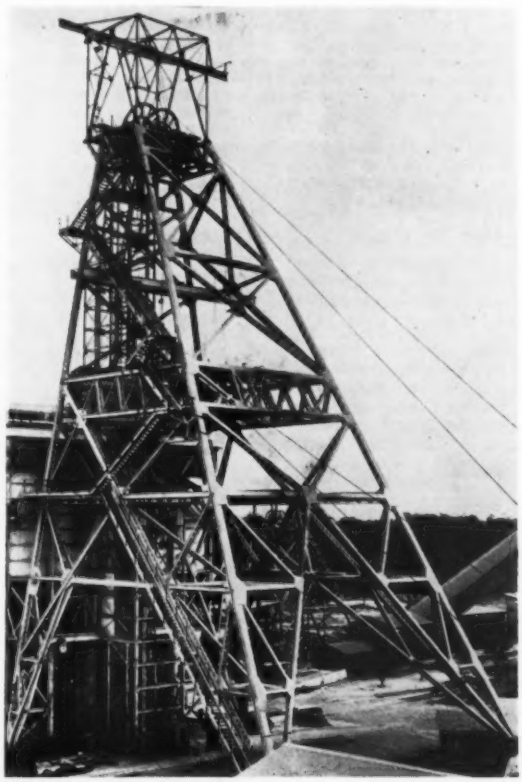
The paradox is resolved only by a closer study of the relationship of the Northern Rhodesian copper industry to the general economy and social milieu in which it is operating. The real national income has indeed grown extremely rapidly since the war but it is the copper mining industry that is mainly responsible for it. The industry was already accounting for two-thirds of the Federal income by the end of the war; it now accounts for about three-quarters; and the probability is that its proportionate contribution will increase. This does not mean that the Northern Rhodesian economy is stagnant. Far from it. It is being expanded as rapidly as possible. But it does mean that its expansion lacks the dynamism possessed by a copper industry which is technically advanced, efficiently managed and organised, adequately capitalised and under the spur of a voracious world demand.

The result has been to create in Northern Rhodesia what Mr. Prain, in his informal talks to British and American stockholders in London and in New York, described as "imbalance." R.S.T. is determined to attempt to rectify the imbalance by helping to create complementary industries. Thus, to counterbalance the predominant mining activity of Northern Rhodesia it is hoped to secure an expansion of agriculture; and to complement the predominant agricultural industry of Southern Rhodesia it is hoped to develop mining of minerals other than copper (for which R.S.T. already has an extensive development programme).

To promote mining activity in Southern Rhodesia (and indeed throughout the Federation) R.S.T. has established Rhodesian Selection Trust Exploration. This company will examine any worthwhile mining proposition outside of the Copperbelt where prospecting is otherwise organised. It is not known, of course, what fields this new venture will provide for R.S.T., but they are unlikely to be wholly unfamiliar to this experienced organization.

In Northern Rhodesia, however, the matter is different. Here R.S.T. is examining the possibility of creating tolerable farming conditions on the Kafue Flats. The Kafue, above the gorges, floods regularly each year and thereby renders uninhabitable a large area of flat land on either bank; this land is the Kafue Flats. It is not quite useless because it is possible to keep cattle on it in some of the winter months. Nevertheless the floods make it impossible to realise the potentialities of the area or even to assess with any great accuracy what those potentialities are. However, it is thought on reasonable grounds that, providing the floods can be controlled, the black soil of the Kafue Flats could be made to bear crops in suitable rotation. Wheat, barley and rice have all been suggested as suitable. It might be possible to control the floods either by building dykes over the normal flood area, or by controlling the river when in flood at some suitable point further upstream. Mr. Prain has suggested that Meshi Teshi might be an effective control point. For the present the whole scheme is still being examined by a firm of Dutch hydraulic and agrarian engineers and it cannot therefore be presumed that it will go forward. Yet the scheme is of such a revolutionary nature, is so far removed from R.S.T.'s normal activities, and invites such immediate comparison with other grandiose agricultural schemes of the post-war era (most of them now abandoned) that it is hard to think that, were there not excellent reasons for expecting its success, R.S.T. would have made its plan public. In any event to say, as has been said, that the Kafue Flats may become one of the sterling area's great wheat raising territories is a bold claim and could only be made after careful thought.

R.S.T. is also assisting in financing railway development, the Kariba hydro-electric scheme, technical education and other comparable schemes. From each of these, the advantage to R.S.T. is more patently direct than that which might accrue from the Kafue Flats scheme. Nevertheless the range of such lending and investing is extremely wide, and the cost heavy.



The Irwin Shaft headframe, Roan Antelope Copper Mines Ltd.

It is not difficult to find the people who will argue that this is a dangerous path for R.S.T. to choose. Certainly, economic history is littered with firms that have fallen for the attractions of vertical integration or of "spreading the risk" by entering new industries, and have failed as a result. It is equally true that history is also littered with the tragic results of the failures of large industries to accept responsibility for economic and political problems which they themselves have helped to create and it can be strongly argued that the economic risks are more than balanced by the political advantages that can accrue. The dangers in the Kafue Flats scheme are obvious enough though the facts that Dutch hydraulic engineers are being retained and that it will be carried forward only tentatively should be adequate safeguard. What, perhaps, is less easy to admit is that there is much element of choice.

Here one returns to Mr. Prain's reflection on the Federation's state of imbalance. Imbalance may easily be a too mild description. It is possible to envisage the copper industry as an economy operating almost independently of the polity in which it is situated; but it is impossible to envisage

such a state of affairs as ending in anything other than disaster. The present prosperity of the Copperbelt makes for strain and misunderstanding. Strain is caused by the fact that labour of all kinds is flocking to the Copperbelt in search of wages and conditions which cannot be had elsewhere. A state of chronic labour surplus is bad for industry, bad for labour and bad for the country. There will be pressure on the industry to absorb labour which it does not want (an inefficient process) and on the government to provide housing and social investment where there is no need (a costly process). Meanwhile other nascent industries may languish through labour shortage and, by languishing, become relatively even less attractive.

The misunderstandings which can arise are equally obvious. What precise meaning, for example, has the phrase "African advancement" when, in the Copperbelt, the African workers now enjoy standards of living comparable with any they could find elsewhere in the continent? This is not to enter into discussion of what is called African advancement, but only to point out the difficulties of discussing it in meaningful terms.

Yet it is precisely because of the relatively high wages paid to Africans on the Copperbelt and the introduction for those employees of relatively advanced living conditions that there are special problems for the Central African Federation in relation to the education and development of Africans throughout the territory. These are not intractable problems yet they do not lend themselves to a quick, easy or sure solution. Awareness of the challenge presented, and mindfulness of the fateful consequences should these difficulties be allowed to grow, has motivated the Group to advance £2,000,000 to the Northern Rhodesian Government and £1,000,000 to the Government of Nyasaland in March last to be spent at their discretion on the capital costs of African development.

PRODUCTION AND COST FIGURES

Roan Antelope 1953/54	Roan Antelope 1954/55		Mufulira 1953/54	Mufulira 1954/55
5,309·5	5,099·6	s. tons milled (000)	3,606·2	3,379·9
2·18%	2·16%	Mill feed (Cu.)	3·24%	3·38%
88,678	82,696	l. tons saleable Cu.	87,972	86,004
£229 19s. 6d.	£170 11s. 8d.	Av. revenue per ton Cu.	£229 17s. 3d.	£273 19s. 0d.
£126 1s. 0d.	£142 0s. 3d.	Av. cost per ton Cu.	£114 4s. 5d.	£133 7s. 0d.
		Financial Results (£000)		
£22,253·1	£25,150·5	Total revenue*	£22,061·9	£26,103·4
£11,136·2	£11,718·4	Operating Costs†	£10,154·1	£11,226·3
£3,308·0	£3,896·0	Taxation	£3,543·0	£4,420·0
£4,728·6	£5,922·7	Net Profit	£4,870·9	£6,393·9
£3,932·1	£4,493·8	Dividends‡	£5,569·4	£5,509·2
£750·0	£1,400·0	General Reserve	£1,050·0	£1,000·0
£93·4	71·6	Carry Forward	£121·5	£42·9
		Ore Reserves		
90,969·9	90,213·0	s. tons (000)	132,065·0	135,635·0
3·20%	3·20%	Grade Cu.	3·48%	3·35%

* Including closing stocks.

† Excluding expenditure in respect of loan interest or replacements.

‡ Mufulira : Dividend for 1954-55 on issued capital of £8,814,790 in £1 shares totalled 20s. a share before Federation Taxes. 1953-54 Interim of 2·6d. after Federal income tax only and final 11s. before all Federation taxes both on issued capital of £8,148,123. In addition special interim dividend (tax free) of 4s. 3·545d. a share.

Roan : Dividends for 1954-55 totalled 4s. a share before Federation taxes on issued capital of £8,987,688. 1953-54, 3·6d. on same capital.

R.S.T.'S GREAT GROWTH POTENTIAL

While providing the stability of a well founded investment company, Rhodesian Selection Trust offers growth prospects which rank high amongst the many organizations engaged in opening up and exploring the vast and unexploited areas in the Central African Federation.

Yet only recently has R.S.T. warranted such a description. Whereas not so long ago the company's function was solely to provide a marketable entity for Mufulira Copper Mines, a subsidiary held as to 63.98 per cent—the Trust's portfolio now includes holdings of 64.29 per cent in Chibuluma, a small but rich copper-cobalt producing mine together with the same percentage in Baluba and Chambishi Copper Mines—both potentially large and valuable mines which are, as yet, in the development stage. These three properties—all subsidiaries—were acquired by R.S.T. in 1954 when Mufulira decided to sell its holdings to members for which purpose a special interim dividend was paid by Mufulira so that its shareholders could take up the shares.

Apart from these actual and potential assets, R.S.T. has taken a stake, directly and indirectly, in Rhodesian Selection Trust Exploration, a company which was formed in June, 1955, with the object of investigating any mining propositions in the Federation—not necessarily associated with copper—lying outside the Copperbelt proper or other nearby situated R.S.T. Group main concession areas. The company has undertaken to provide 15¼ per cent of R.S.T. Exploration's capital, the balance being put up by Mufulira and Roan Antelope Copper Mines as to 42¼ each.

In addition, through Mufulira, R.S.T. has an indirect interest in four other exploration organisations, Mwinilunga, Luapula, Kadola and Chisangwa Mines. These companies which (except for Chisangwa) are owned as to 45 per cent by Mufulira and Roan Antelope Mines (the remaining 10 per cent being held by the British South Africa Company), form an essential part of the extensive exploration activities of the R.S.T. Group.

R.S.T.'s total consolidated revenue in respect of the year ended June 30, 1955, at £12,147,083 showed a dramatic increase from the preceding year's figure of £9,660,468. After all expenses, including taxation of £4,401,011 against £3,550,550, group profits attributable to R.S.T. after deduction of minority interests rose sharply to £4,035,032 from £3,091,023. Dividends of 4s. 9d. on the issued ordinary capital of £5,654,790 in 5s. shares absorbed a net figure of £3,357,531. A total of £2,316,058 was taken in respect of the previous year representing distribution on the smaller capital of £5,293,846. At the same time carry forward was reduced to £15,168 from £209,350. During the past financial year R.S.T.'s authorized capital was increased to £6,000,000 by the creation of a further 2,000,000 ordinary shares of 5s. Subsequently the issued capital was raised to £5,654,790 by offering shareholders 1,443,776 shares at 17s. 6d. This provided £1,263,304 of which £1,200,600 was utilised in subscribing for 400,200 Mufulira shares at £3 per share. Since the end of the financial year a further 19,475 shares in Mufulira, together with a proportionate number of shares in Chibuluma, Baluba and Chambishi were acquired.

WALL STREET QUOTATION

An important event of the past year was the granting of a quotation for R.S.T. shares by the New York Stock Exchange. R.S.T. was also introduced unofficially to the Brussels Bourse through facilities afforded by the Banque Lambert in Brussels.

At June 30, 1955, the company's consolidated balance sheet showed total assets of £40,665,494 as compared with £33,657,425 in respect of the previous year. Current assets of £24,417,023 exceeded current liabilities of £14,960,462 by £9,456,462.

MUFULIRA'S EXPANSION PLANS MATURE

During the past few years Mufulira Copper Mines has been engaged in a large programme of capital expenditure. A plan for enlarging its electrolytic refinery from the original capacity of 36,000 tons a year to 72,000 tons has been put into effect and is expected to become fully operative this year. At the same time the company's ore mine and mill capacity—previously rated at 285,000 tons a month—is scheduled to be stepped-up—also by 1956—to about 340,000 tons monthly. This has been made possible by going over to simultaneous mass caving of the property's three orebodies; completing a new hoisting shaft and extending the mill facilities. Another feature of the expansion programme has been the construction of a third reverberatory furnace at the smelter.

While capital investment had entailed expenditure of over £11,000,000 during the first nine years since the war, the amount of construction work still on hand at Mufulira at June 30, 1955—the end of the company's past financial year—still totalled £3,785,000.

To make some provision towards meeting these expenses, Mufulira issued 666,667 ordinary shares of £1 last year to shareholders at a price of £3 per share. This provided £2,000,000 and raised the company's issued equity to £8,814,790.

Mufulira's capital investment over the past few years must soon result in higher profitability. But hopes for increasing dividends must be conditioned by considerations of the great financial outlays still envisaged. These are necessary, not only

for developing the property itself, but to enable Mufulira to take its part in financing such projects as the Kariba Gorge Hydro-Electric Scheme. Furthermore, although Mufulira has divested itself of its previous holdings in Chibuluma, Baluba, and Chambishi Mines, it is still substantially interested in the exploration activities of Mwinilunga, Luapula, Kadola and Chisangwa Mines, all of which will need funds for their exploration activities. A further commitment is represented by a participation in the newly-formed Rhodesian Selection Trust Exploration Company.

Profits during 1954-55 made a great advance over those of the previous year. This trend has been continued during the current financial year and quarterly reports covering nine months ended March 31, 1956, have revealed a further rise in net profits before taxation to £12,558,000 from £8,271,000 during the previous corresponding period.

Mufulira's balance sheet at June 30, 1955, revealed total assets at £34,061,179 as against £28,617,712 in respect of the previous year. Net liquid assets totalled £8,697,433 as against £8,107,160.

CHIBULUMA STARTS PRODUCTION

Financed primarily by the United States Defence Materials Procurement Agency who agreed to lend up to £5,000,000—repayable by way of metal deliveries—Chibuluma Mines, a small but rich copper-cobalt producer on which initial work was started in 1951, reached production in the latter part of 1955. The company is a subsidiary of R.S.T. which holds 64.29 per cent of its £1,000,000 issued equity capital. Estimated ore reserves at the property as at June 30, 1955, amounted to 7,300,000 tons of ore averaging 5.23 per cent copper and 0.25 per cent cobalt.

The total cost of developing and equipping Chibuluma—including the construction at Ndola of a cobalt treatment plant costing about £500,000—has recently been re-estimated at £6,500,000.

Output is expected to continue at Chibuluma at an average rate of about 18,000 tons monthly until initial stopes have been opened up. Thereafter the company should be in a position to hoist at its rated capacity of 40,000 tons a month.

The concentrating plant at Chibuluma, designed to treat 40,000 tons of ore monthly, which had been under construction since July, 1954, was officialy opened on May 5, 1956, by Lord Llewellin, Governor-General of the Federation of Rhodesia and Nyasaland. Unfortunately, the coming into production of this installation—whose purpose it is to separate and prepare cppper-cobalt minerals for smelting at Mufulira—had been held up by delays in deliveries of essential steelwork. Accordingly, since October, 1955, when hoisting first started at the mine, ore had been stockpiled awaiting treatment by the concentrator. It should thus, not be long before Chibuluma starts actual deliveries of copper and cobalt.

BALUBA AND CHAMBISHI

Having proved some 70,000,000 s. tons of sulphide ore averaging 2.68 per cent copper and 0.18 per cent cobalt, Baluba represents a large and potentially valuable mine. Moreover, it is thought that the property contains one of the greatest undeveloped deposits of cobalt in the world.

Ore reserves of about 25,000,000 s. tons averaging 5.46 per cent copper are known to exist at Chambishi Mine. Chambishi is, of course, a considerably smaller proposition than Baluba and contains no cobalt.

FORMATION OF RHODESIAN SELECTION TRUST EXPLORATION

A tangible expression of the R.S.T.'s Group's intention to take its appropriate part in developing resources other than copper in the Central African Federation, was the formation last July of Rhodesian Selection Trust Exploration with a nominal capital of £100. Shortly after registration, this organisation increased its capital to £1,000,000. It is stated that R.S.T. will provide 15¼ per cent of Exploration's funds, the balance being subscribed by Mufulira and Roan Antelope Copper Mines as to 42¼ per cent each.

R.S.T. Exploration's objectives are to examine mining propositions within the Federation but outside the Copperbelt or main concession prospecting areas in that vicinity. Investigations are at present being carried out involving apatite, tungsten, ilmenite and rutile, gold, copper, chrome, asbestos, tin, nickel, monazite, beryl and lead.

R.S.T. GROUP PROSPECTING COMPANIES

Prospecting for what has aptly been described as "another Copperbelt" has been conducted energetically by the R.S.T. Group for some years. This work is being done under the auspices of Mufulira, Roan Antelope and the British South Africa Company.

During 1951 the interested parties decided to take up exclusive prospecting licences over further large areas in Northern Rhodesia. This resulted in the formation of four prospecting companies, Mwinilunga, Chisangwa, Luapula and Kadola Mines. Apart from Chisangwa, in which Mufulira holds only 30 per cent, the capital of these companies has been subscribed as to 45 per cent by Mufulira and Roan Antelope Copper Mines and 10 per cent by the British South Africa Company. The issued capital of Chisangwa is £235,000, Mwinilunga £350,000, Kadola £150,000 and Luapula £115,000. Collectively, the areas over which rights are held amount to some 41,500 square miles.

An interesting announcement made towards the end of 1955 concerned an arrangement made between Mwinilunga Mines and New Consolidated Prospecting Company (Pty.). This provided for the latter company to carry out mineral prospecting operations over certain parts of the area covered by Mwinilunga's exclusive prospecting rights. This work will be spread over a period of four years and a full exchange of technical information will take place between the two companies.

ROAN'S IMPROVED "LIFE"

Roan Antelope's earning capacity is not much smaller than that of Mufulira, which ranks as the R.S.T. Group's most important mine. Yet despite its virtual equality with Mufulira in providing group revenue, uncertainties about Roan's potential "life" have placed the company in a somewhat lower category than that of its sister mine. While this assessment has to some extent been justified, it is also necessary to bear in mind that at Roan's present rate of milling nearly 18 years of productive life still remain. This represents a sound technical position but, naturally, when compared with Mufulira's 40 years does not appear so impressive.

The question of "life" at Roan has recently been the subject of some re-appraisal. Indeed as the result of exploration on the Roan Extension, considerable tonnages have been added to reserves. During the past financial year ended June 30, 1955, these amounted to nearly 5,000,000 tons. Additionally drilling has been continued on the company's Muliashi Special Grant, the results of which could have an important bearing on the future.

Following R.S.T. Group policy which aims at producing electrolytic copper rather than blister, Roan formed a subsidiary company—Ndola Copper Refineries—in 1954 with the object of building a 55-60,000 ton capacity refining plant at a cost of £3,000,000. Of this figure Roan was to provide £2,000,000 while British Insulated Callendar's Cables, one of Roan's largest U.K. customers, undertook to provide the other £1,000,000. An initial target production date was set for the second half of 1958.

Since the end of Roan's past financial year, however, this scheme's potential has been substantially enhanced. Output will now be doubled to 110,000 l. tons of electrolytic copper by 1960 at an extra cost of £1,500,000. Ndola's nominal capital, of which only £1,000,000 is yet in issue, will be raised to £4,500,000 by the creation of an additional 1,500,000 shares of £1 each.

Roan must face capital expenditure of about £3,300,000 during each of the coming four years. This is necessary in order to maintain plant and mine in a condition to continue production at the present scale. In addition, contributions have also to be made for financing Kariba power, besides which the exploration activities of Mwinilunga, Luapula and Kadola Mines—in which it holds 45 per cent—and 30 per cent in Chisangwa will also make financial demands. Despite these commitments the company is able to face the future with growing confidence both from a financial and a technical standpoint.

Roan's consolidated balance sheet at June 30, 1955, showed total assets of £31,988,475 compared with £30,320,884 previously. Net liquid assets totalled £9,997,906.

Quarterly reports covering the nine months ended March 31, 1956, reveal a rise in net profits before taxation earned by Roan to £11,031,000 from £7,400,000 during the previous corresponding period of the past financial year.

Tanganyika Concessions Limited

THE continued progress and prosperity of Central Africa were fully illustrated by the increased earnings of Tanganyika Concessions Limited for the year ended July 31, 1955.

The company was formed in 1899 by the late Sir Robert Williams, Bt., for the pursuit of exploration and development projects in Africa. Following the discovery of large and valuable mineral deposits in a Concession obtained by Sir Robert in the Belgian Congo, the Union Minière du Haut-Katanga was formed in 1906. Tanganyika Concessions Limited continue to participate in the fortunes of Union Minière du Haut-Katanga to the extent of 179,760 Parts Sociales, which, at July 31, 1955, had a value, based on the market quotation in Brussels, of £85,386,000, as compared with a book value of £4,338,513. In addition to this Tanganyika Concessions Limited hold 61,384 4½% Obligations of 100 Belgian Francs each, and are entitled to participate in Mining Royalties payable by Union Minière du Haut-Katanga. During the year ended July 31, 1955, the company's share of the Royalty amounted to £536,735.

The financial year ended July 31, 1955 of Tanganyika Concessions Limited was an important milestone in the history of its investment in the Benguela Railway Company. During this period Tanganyika Concessions Limited received its first dividend from this subsidiary company. The Ordinary Dividend was at the rate of 10%, in respect of the financial year to December 31, 1954, and the Benguela Railway Company also paid the current interest on its 4% Income Debentures and 5% Debentures as well as the arrears of interest on the 4% Income Debentures for the years ended December 31, 1951, 1952 and 1953. Tanganyika Concessions Limited continue to hold 90% of the Issued Share Capital and all the Debentures of the Benguela Railway Company.

The following table shows the company's results since the transfer of the seat of control to Southern Rhodesia :—

Year to July 31	*Total Income*	*Total Expenses*	*Taxation*	*Net Profit*	*Dividend*	*Carry Forward*
	£	£	£	£	%	£
1955	3,253,207	152,377	100,000	3,000,830	70	1,903,290
1954	2,718,575	99,293	100,000	2,519,282	55	1,383,544
1953	2,301,491	99,843	143,734	2,057,914	45	995,999
1952	2,098,697	121,307	150,000	1,827,390	40	809,790
1951	1,272,302	103,671	56,955	1,101,676	25	279,394

The increased dividends of Tanganyika Concessions Limited for the year to July 31, 1955, thus reflect the continuing good fortunes of both Union Minière du Haut-Katanga and also of the Benguela Railway Company.

UNION MINIERE DU HAUT-KATANGA

Prospecting work during 1954 was again pursued in the western part of the concession with satisfying results. Ore reserves developed during the year largely compensated for the tonnages extracted. During the year 7,438,000 metric tons of ore were mined and 9,100,000 cubic metres of barren material excavated.

Total copper output was once again a record, being 223,791 metric tons for 1954, as against 214,116 for 1953. Cobalt output was 8,609 metric tons, 5,362 tons in the form of cobalt granules and 3,247 tons contained in cobalt alloy produced at the Panda electric furnaces. 150,331 metric tons of zinc concentrates containing 54.8 per cent. of zinc were produced, and 30,826 Kgs. of Cadmium were recovered from the flue dusts from the zinc concentrate roasting furnaces. The Hoboken Metallurgical Company produced 167 tons of lead, 141,526 Kgs. silver, 84 Kgs. gold and 1,095 Kgs. germanium oxide from products sent to them for refining. The exportation of uranium and radium ores, concentrated in the works at Shinkolobwe, has continued.

The capacity of the concentrator at Kolwezi has been raised to 245,000 metric tons of ore per month, and work on a new extension to increase the capacity of the Shituru Electrolytic Plant from 112,000 to 125,000 tons per annum was to be started in 1955.

The construction of the Delcommune Hydro-Electric Power Station was completed by putting into service the third generator set in March and the reserve generator in September, 1954. The total capacity of this station is 120,000 kVA. The work on the construction of the Marinel Hydro-Electric Power Station with its projected capacity of 276,000 kVA, has been actively pursued and has conformed to the programme to bring the four groups into operation progressively between July, 1956 and May, 1957.

The production of power at the three hydro-electric stations reached a record of 955 million kilowatt-hours in 1954, supplemented by 17 million units from the Panda Steam Plant and auxiliary Diesel units.

BENGUELA RAILWAY COMPANY

The accounts of the company for the year ended December 31, 1954 show a profit for the year of Escudos 127,163,194, as compared with Escudos 77,368,410 for 1953. This improvement was due to a rise in receipts of Escudos 40,151,785, combined with a reduction in working expenses in Africa from Escudos 206,881,425 in 1953 to Escudos 200,099,187 for 1954. The preliminary figures for 1955 show that the improving trend continues. Capital Expenditure during the year totalled £775,000, and at January 1, 1955 the Capital Expenditure Programme covering the years 1955/57 amounted to £2,112,000.

In order to provide the Railway Company with funds to finance this capital development, Tanganyika Concessions Limited subscribed for £2,250,000 of Benguela Railway Company's 5% Debentures, at a discount of 10%, on February 1, 1955. Funds for the purchase of the Debentures were provided by the issue by Tanganyika Concessions Limited of £2,000,000 4½% Unsecured Loan Stock 1965/75.

TANGANYIKA HOLDINGS LIMITED

Tanganyika Holdings Limited was formed in 1950 in order to take over the Northern Rhodesian and East African interests of Tanganyika Concessions Limited and The Zambesia Exploring Company Limited. These now principally consist of holdings in Rhodesia-Katanga Company Limited, Kansanshi Copper Mining Company Limited, and Kentan Gold Areas Limited (see page). The main asset of Kentan Gold Areas Limited is its 78.63% interest in the equity of Geita Gold Mining Company Limited, a 20% interest being held by that company's Consulting Engineers, New Consolidated Gold Fields Limited.

Tanganyika Holdings Limited act as Registrars in London for Tanganyika Concessions Limited, and supply office services for the associated companies in the group.

RHODESIA-KATANGA COMPANY LIMITED

In December 1954 Kansanshi Copper Mining Company Limited exercised its option to purchase the Kansanshi Mine in N. Rhodesia from Rhodesia-Katanga Company Limited, which retains 35.24% of the equity of the Kansanshi Company. The other shareholders include Anglo American Corporation (41.37%), Selection Trust Group (10.41%), Tanganyika Holdings Limited (6.61%) and The British South Africa Company (4.88%), and Anglo American Corporation are acting as Consulting Engineers. Good progress is being made with a programme to equip the mine to concentrate 12,000 tons of sulphide ore per month, and milling is expected to commence in the last quarter of 1956. The profits obtained from exploitation will be used to investigate extensions of vein ore beyond that already known to exist, and at the same time investigations are being made as to the possibilities of treating economically the large reserves of oxide ore which lie close to the surface. The problems of de-watering the mine are being successfully overcome and development results announced to date are not unpromising.

The Rhodesia-Katanga Company also owns perpetual coal-mining rights in 20 areas of 300 acres each and perpetual mineral rights over an area of about 2,500 square miles, both subject to 15% interest of the British South Africa Company. Comparatively little exploration has been done in the past on these areas, which lie between Broken Hill and the Loangwa river, but arrangements have now been made for an exploration programme under the direction of Rio Tinto Finance and Exploration Limited as Consulting Engineers. Contributions towards the expenditure, which is anticipated to amount to some £150,000 over a period of three years, will be made as to 33⅓% by Rio Tinto and 7½% by the British South Africa Company.

Kentan Gold Areas Ltd.

DURING this difficult inflationary post-war period, a good deal has been happening to improve the outlook for Kentan Gold Areas whose assets are virtually represented by a holding of about 79 per cent in Geita Gold Mining Company, its subsidiary. In consequence, after more than 20 years' operations during which a dividend paying stage was never reached, prospects of this being achieved in the near future are now better. While this change in fortune has been principally due to the opening up of rich gold-bearing orebodies in the N.E. Extension of the Geita Mine, much can be attributed to plans for improvements in production capacity, development and treatment efficiency introduced by the consulting engineers, New Consolidated Gold Fields.

In fact, only two major obstacles prevent Geita from attaining a yearly mill capacity of 360,000 tons and earning working profits of between £80,000 and £150,000 per annum. The first of these—the provision of sufficient African labour—appears to be yielding to treatment. The second, the rehabilitation of mechanical engineering facilities, has been in hand since New Consolidated Gold Fields Limited injected £100,000 of new capital into the Geita Company in 1954, and is essential before output can be increased.

1954/1955 A SUCCESSFUL YEAR

Although Geita's new plans obviously still remain to get into their stride, the year to June 30, 1955, gave some taste of the better things to come. Working profits expanded to £48,755 from £7,646 and carry forward rose to £60,139.

An encouraging event which took place shortly after the past financial year was that Tanganyika Holdings Limited extinguished its unsecured interest-free loan to Kentan Gold Areas Limited of £306,000 by converting it into shares of the company at par. This brought Kentan's issued capital up to £1,000,000 in shares of 1s. from the previous figure of £675,000.

During the first six months of the current financial year 135,200 tons have been milled as against 133,100 tons during the previous corresponding period. Profits were £23,842 compared with £22,617.

Geita consists of five different sections: the Geita mine itself, the N.E. Extension, Lone Cone, Prospect 30 and Ridge 8. Another property named Mawe Meru has been operated on a tribute basis since December, 1955.

Year to June 30	*Tons Milled* (000)	*Ounces Gold Recovered*	*Yield per ton* (*dwt.*)	*Cost per ton Ftge.** (*shillings*)	*Devt.* (000)	*Ore Reserve tons†* (000)
1955	273.2	41,087	3.01	34.78	6.2	1,403.0
1954	256.5	38,952	3.04	38.17	8.3	1,364.0

* Excludes footage charged to capital account.
† Value 4 dwts. per ton in both years.
N.B.—Extraction 1954/55 85.2% (1953/54—85.3%).

Figures showing tonnages and values of ore reserves at each individual section are not published. It is, therefore, only possible to assess the property as a whole. Broadly speaking, the greater proportion of ore treated at the mine is drawn from the Geita workings. But as opening-up work progresses at the N.E. Extension Block it is thought that tonnage from this source together with that from Geita will absorb all the present mill capacity. Moreover exploration and development has been intensified at the other sections, particularly Prospect 30—an opencast proposition—and it is clear that larger reserves will soon be established. This will, however, present no treatment problems.

LATERAL DEVELOPMENT ON N.E. EXTENSION

In spite of its difficult geological structure, work on the N.E. Extension Block has yielded some most encouraging results. So far, four orebodies have been disclosed in Adit 535 on 3 Level. Widths have been erratic, varying from 4 feet to as much as 28 feet but values seem to indicate a gold content of over 6 dwts. per ton, although adjustments may be required when estimating ore reserves. Development is being pushed ahead with the object of establishing stope faces quickly and probing on 4 Level for the downward extensions of the orebodies disclosed on 3 Level.

Last year an S.E.P.L. of 123 square miles surrounding the main Geita Mining Leases and Claims was granted by the Tanganyika Government.

The Zambesia Exploring Co. Ltd.

ANY brief appraisal of The Zambesia Exploring Company is likely to give an erroneous impression of its importance and sphere of influence. Indeed, a conclusion formed from balance sheet figures alone is apt to obscure what role the company actually plays in the associated group to which it belongs. Figures alone cannot provide this explanation, yet, acting as a group finance organisation Zams has been directly responsible for a number of great mining developments in Central Africa. The most important of these was the formation of Tanganyika Concessions in the year 1899.

In fact Zams still retains a very large stake in Tanganyika Concessions, which is held through a wholly owned subsidiary called The Zambesia Investment Company, and is regarded as a "fixed" investment. The company also holds 50 per cent in Tanganyika Holdings — owned jointly with Tanganyika Concessions — which has interests in Kentan Gold Areas and Rhodesia-Katanga.

In order to adjust the company's financial period to that of the fiscal year, the year-end has been changed from December 31, to March 31, and the latest published accounts therefore reflect 15 months' operations instead of the customary twelve. The accounts of the parent company and its subsidiary are not consolidated, the one being a finance and the other an investment company, but the results taken separately would give a misleading impression. A table has therefore been compiled showing group figures for the four accounting periods to March 31, 1955, together with the recently published preliminary figures for the year to March 31, 1956. This shows that despite the payment of a generous dividend, the group's reserves have continued to grow. The parent company's assets at March 31, 1955, were valued at £1,335,806, this figure included the underlying quoted investments of the group which had at that date a market value of no less than £3,103,082.

In order to provide funds for its interests in the exploration and development of Central Africa, £43,266 of unissued capital was in June 1955 offered to stockholders at par on the basis of £1 stock for every £20 stock already held. The offer is, with C.I.C. consent, being repeated this year on the same basis.

TANGANYIKA HOLDINGS' GROWTH POTENTIAL

The two main interests of Tanganyika Holdings lie in Kentan Gold Areas, which owns the promising Geita gold mine in Tanganyika and in Rhodesia-Katanga which has a participation of 35.24 per cent of the developing Kansanshi copper property in Northern Rhodesia. In addition, a small direct holding in Kansanshi of 6 per cent is held while the Geita interest is enhanced by Rhodesia-Katanga's block of shares in Kentan Gold Areas. Both Geita and Kansanshi have considerable growth prospects. Tanganyika Holdings also has a 30 per cent participation in an exploration programme being carried out by Rio Tinto over some 12,000 sq. miles in Northern Rhodesia.

At June 30, 1954, the company's assets rose to £974,414 from £893,606 previously. Quoted investments shown at £415,399 had a market value of £432,418. During the past financial year Tanganyika Holdings made net profits of £1,945 against £3,132. Carry forward rose to £6,163 from £6,071.

THE ZAMBESIA EXPLORING COMPANY LIMITED : GROUP RESULTS

Period	*Profit Sale of Investments* £	*Other Income* £	*Total Income* £	*Expenses* £	*Profit before Taxation* £	*Taxation* £	*Profit after Taxation* £	*Dividends Paid* £	*Total Reserves (including carry-forward)* £
Yr. to Dec. 31, 1951	122,305	105,772	228,077	11,197	216,880	101,228	115,652	90,860 (20%)	495,263
,, ,, ,, ,, 1952	54,545	124,610	179,155	11,717	167,438	99,669	67,769	68,145 (15%)	491,313
,, ,, ,, ,, 1953	76,470	115,031	191,501	10,814	180,687	109,286	71,401	71,390 (15%)	495,729
15 Months to Mar 31, 1955	Dr. 23,700	346,262	322,562	14,291	308,271	141,564	166,707	107,733 (22%*)	557,661
Yr. to Mar. 31, 1956	46,336	157,023	203,359	12,874	190,485	101,456	89,029	91,428 (17½%)	605,832

*Equivalent to 17.6% for 12 months.

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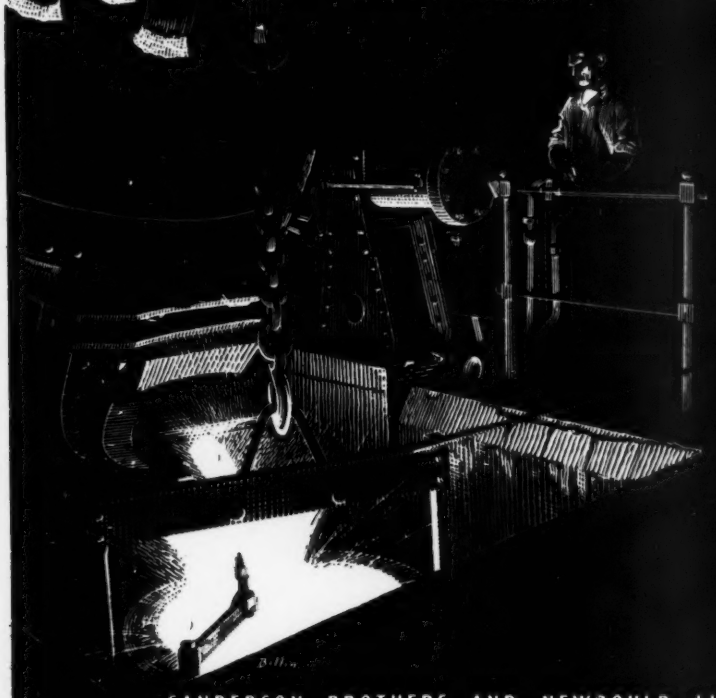

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AGENTS IN ALL PARTS OF THE WORLD

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Selection Trust Limited

THE interests of Selection Trust and its subsidiary, Seltrust Investments, are widely spread in various forms of mining, including copper, lead-zinc, diamonds and gold, but the base metal investments predominate, and it is to the sustained strength of these metals in world markets that the company owes the recovery which occurred in its earnings for 1954-55, and the further improvement which will certainly be shown by the accounts for the year which ended at March 31, last.

The interest in Rhodesian copper production is held through its 25 per cent participation in the common stock of the American Metal Co., which owns 50.6 per cent of the capital of Rhodesian Selection Trust, giving it an effective 32 per cent participation in the Mufulira mine and a similar interest in Chibuluma, where the concentrator plant was officially opened on May 5, 1956. American Metal also owns 32.6 per cent of the capital of Roan Antelope Copper Mines, 28.5 per cent of the equity of Tsumeb Corporation, a large South West African lead-zinc producer, and 19.7 per cent of the capital of O'Okiep Copper, a South African copper company which is also a shareholder in Tsumeb. American Metal also operates lead and zinc mines in Mexico, a potash mine in New Mexico, and numerous base metal smelting and refining plants dealing with its own products as well as those of other mines. A more recent venture, arising from its active exploration programme, is a 75 per cent interest in Heath Steele Mines, which is expected to begin production at its lead-zinc-copper property in New Brunswick in the course of next year.

At the recent market price of $64 for American Metal, Selection Trust's holding of 794,466 shares was worth £18,100,000, which is equal to 81s. for each of its own 10s. Ordinary shares, and compares with a quotation of 89s. The small difference may be taken as a very conservative valuation of Selection Trust's other interests.

The Group has a direct interest of over 14 per cent in Tsumeb Corporation which is now one of its principal sources of income and a substantial investment in Consolidated African Selection Trust provides an important stake in the diamond business. It has valuable participations in new gold mines through holdings in Vaal Reefs Exploration, whose gold and uranium plants came into operation on May 1, 1956, and in Western Holdings and St. Helena both of which are now dividend payers.

Selection Trust and Trepca Mines have a majority interest in Bikita Minerals (Private) which owns a large deposit of lithium-bearing ores in Southern Rhodesia. Lepidolite ore has been sold to glass manufacturers but the main production is being delivered under a long-term contract to American Lithium Chemicals Inc., (which is jointly owned by Bikita and American Potash and Chemical Corporation) for the manufacture of chemicals.

Selection Trust through its Toronto subsidiary, Selco Exploration Company, is actively engaged in mining investigation work in Canada. A skilled organisation has been established there which is actively in search of new business. During 1955 Selco negotiated an agreement with Thompson Grubstake, 1955, a Canadian prospecting syndicate, for the acquisition of 80 claims over a copper-nickel prospect in Quebec and a public company named Lake Renzy Mines was formed to acquire and investigate the claims.

Consolidated Results

Year to Mar. 31	*Total Revenue**	*Taxation*	*Net Profit*	*Ord. Dividends*	*To Reserve*	*Carry Forward*
	£000s.	£000s.	£000s.	£000s.	£000s.	£000s.
1955	2,204.1	1,032.8	1,102.1	636.3	402.5	453.2
1954	1,577.0	830.5	678.0	524.2	102.5	414.6
1953	1,966.6	1,145.9	752.8	517.2	152.5	390.6

* Including profits on sale of investments:- 1955, £176,788; 1954, £42,491; 1953, £208, 181.

In addition to raising the dividend from 4s. 3d. to 5s. per unit of stock last year, Selection Trust distributed one unit for each twenty held by capitalising reserves. There is no doubt that 1955-56 has been a buoyant year for the company because American Metal has increased its cash dividend from $1.75 for 1954 to $3 for 1955, and again distributed a 5 per cent stock dividend. Tsumeb has also had a very good year and usually keeps its dividend in step with earnings. Finally, the Orange Free State gold dividends will have added something to the current year's income. The interim dividend of Selection Trust for 1955-56 was raised from 1s. 6d. to 1s. 9d. per share and is probably a guide to the board's intentions in the matter of a further distribution to Stockholders. The Directors' Report and Accounts are usually issued during June.

Consolidated African Selection Trust

THE year 1955 brought a most important development in the affairs of Consolidated African Selection Trust when its wholly-owned subsidiary, Sierra Leone Selection Trust, negotiated the surrender of a considerable part of its exclusive rights to mine diamonds throughout the greater part of the territory and agreed to accept £1,570,000 in compensation. For several years past operations in Sierra Leone have been made difficult and expensive by illicit mining in the company's areas, and more recently it had become apparent that the Government had no effective methods of checking this illegal trade, which was having serious adverse effects on the economic situation of the colony. Sierra Leone Selection Trust was therefore approached with a request that it should give up large areas which would be made available for licenced digging by Sierra Leoneans.

The broad outline of the agreement is that, instead of having exclusive rights to mine diamonds over virtually the whole of the territory, an area of 28,000 square miles, S.L.S.T. will restrict its working to approximately 200 square miles, and will have security of tenure for fifteen years with the right of renewal for further periods aggregating another fifteen years. In addition the company will have the right to take up leases over further areas of 250 square miles, with certain restrictions, and the right to prospect for and mine deep deposits in the areas surrendered for a minimum of ten years.

Whether the company has received adequate compensation for giving up its rights over such a large tract of country only the future will tell. All its proved reserves are in the 200 square miles which are secured to it. But it was to the outside areas, no longer available to it, that the company was looking for deposits to be worked in the more distant future. At first sight the compensation seems a substantial sum ; it becomes less significant when it is realised that it represents just two years' gross profits from Sierra Leone at the lower level of earnings which prevailed last year.

Operating experience during the year to June 30, 1955, was reasonably good in the Gold Coast, but less so in Sierra Leone. In the former territory, production was maintained, a decline in the average grade of ground treated being offset by a larger yardage. Operating expenditure remained much about the same as in the previous year. The chief product of the Gold Coast mines is industrial stones, demand for which was high through most of the year, and in consequence sales were in excess of actual production. Mainly for this reason Gold Coast profits improved from £682,000 to £1,033,000, but taxes of various kinds continued to be a heavy drain on income, royalties, mineral duty, income tax and profits tax absorbing nearly 64 per cent of profits, and leaving a net balance of £375,000, compared with £186,000 for 1953-54.

In Sierra Leone output was rather more than maintained, but a sharp increase in operating costs brought about chiefly by the soaring cost of rice which the company supplies to its workers at a low fixed price, coupled with a 20 per cent drop in caratage sold, reduced the gross profit from £1,268,000 to £773,000, and the net balance after taxes from £518,000 to £305,000.

The final outcome was a net consolidated profit of £892,000, or £77,000 more than for the previous year. The apparent cover for the dividend costing £654,000 was thus a little better, but if the transfers to specific reserves are regarded as a charge on profits — a course for which there is some justification in that large sums are being spent annually from these reserves — then the dividend for the past year was covered only with the help of part of a £150,000 tax recovery.

Consolidated Results

Year to June 30	**Total Mining*	*Revenue Dividends etc.*	*Taxation*	*Net Profit*	*Net Dividends*	*To Reserve*
	£000	£000	£000	£000	£000	£000
1955	1,738.8	492.0	1,174.7	892.7	654.0	351.9
1954	1,914.7	443.7	1,412.0	815.9	625.6	380.5
1953	*2,036.6	555.2	1,412.0	1,051.9	625.6	550.5

† Including £386,819 from special sales of stocks.
* After providing for Gold Coast minerals duty : 1955, £191,813 : 1954, £144,654: 1953, £202,671.

The immediate outlook is fairly satisfactory. Demand for diamonds remains high and the sales contracts have been renewed until 1960. The group's financial interest in the Companies concerned in the central marketing organisation should continue to yield a very satisfactory revenue, and the Company's liquid position is strong. Future profits from the Company's field operations, however depend on the success of its efforts to keep expenditure down in the face of rising wages and increasing cost of materials.

Western Selection and Development Co., Ltd.

ON November 20, 1955, a strike of native workers began on the Gold Coast gold mines which virtually stopped the industry for just over three months, and which was to affect production even after operations had been resumed. In view of the seriousness of the position to the Gold Coast Government, a Statutory Board of Inquiry was set up to investigate (1) the economic condition of the mining industry, with particular reference to the claim by the gold miners for higher wages, and (2) the method of fixing wages in the industry.

Since a major portion of the investment portfolio held by Western Selection, formerly known as Gold Coast Selection, is in companies operating in British West Africa namely—Amalgamated Banket Areas, Ariston Gold, Bremang Gold Dredging, Gold Coast Main Reef and Marlu Gold Mining which is now in liquidation — this finance house has a great interest in the settlement of this dispute. Quite apart from the considerable amount of money representing standing charges which has to be paid out during the strike, it ought also to be borne in mind that the companies have had to forego their profits which, in total, can reasonably be said to amount to £250,000. Moreover, until the Board of Inquiry publishes its report and negotiations have been completed, no account can be taken of what the potential burden on the industry may be in the future.

The Western Selection Portfolio is not, however, entirely dependent on income from these Gold Coast companies. It has holdings in the Nigerian tin-columbite producers, Bisichi Tin, Gold and Base Metals and Ex-Lands Nigeria. These companies are having to adapt themselves to the changed conditions since the U.S. Government declared that it would enter into no more new contracts for the purchase of columbite at premium prices. Investments also include interests in mines operating in other spheres, giving an even wider spread of interests.

WESTERN SELECTION'S CANADIAN VENTURE

During 1954 Western Selection decided to extend its activities into that great land of mining promise, Canada, by acquiring nickel-copper claims in Northern Manitoba and uranium claims at Higginson Lake in Northern Saskatchewan. A Canadian company, Anglo Barrington Mines, has been registered to prospect, develop and exploit these claims. Drilling is being carried out but the areas are so large that a completely comprehensive examination has not been possible in the comparatively short time since the claims were acquired. The prospects are sufficiently encouraging for the Treasury to grant permission for the expenditure of a large sum in dollars — in all, $500,000. This was unlikely to be enough, and thus arrangements have been made with the Construction Equipment division of Baldwin-Lima Hamilton Corporation for a $1,600,000 Line of Credit by the Export-Import Bank. This credit can be used for the purchase of plant and machinery in the United States and Canada, and it can be paid for by the shipment of minerals over a period.

During the financial year to September 30, 1955, the Western Selection's total revenue dropped, the most important factor being smaller dividend and interest receipts, a decline which was only partially made good by bigger profits on share-dealing.

For the financial year ended September 30, 1955 profits were down to £102,066 from £128,903, but they were still large enough to have repeated the 1953-54 dividends of 17½ per cent. But in view of the reduction in dividends from the Gold Coast companies as a result of the three months strike, and financial commitments in West Africa and in Canada, the board decided to retain £48,160 of the year's profits. During the current year it will have the use of the money raised by a new issue in March, 1955, for a whole year, instead of for six months as in 1954-55. This issue raised the issued ordinary capital from £750,000 to £937,500.

Year to Sept. 30	*Dividend Income*	*Sales of Investments*	*Taxation*	*Net Profit*	*Dividend*	*Profits retained*
	£	£	£	£	%	£
1955	96,035	21,796	8,205	102,066	10	48,160
1954	123,385	18,776	1,215	128,903	20	46,403
1953	106,753	3,715	1,628	87,746	15	25,871
1952	110,630	2,357	9,187	83,517	12½	34,298
1951	86,628	19,449	10,753	87,983	12½	38,651
1950	113,373	28,514	31,774	102,492	7½	71,555

At the end of last September the balance sheet position was strong, current assets being carried in the books at £561,069 and current liabilities at £65,635. In addition the portfolio of quoted investments mentioned above had a market value of £1,056,869.

AMALGAMATED BANKET AREAS LIMITED

The year to September 30, 1955, appears to have been one for which shareholders had long been waiting. Earlier, the opening of the Fanti section had imposed a strain on the company's resources, but in 1953-54 it started to contribute ore and revenue to the general fund and, in 1954-55, the section contributed 103,282 tons averaging 4.05 dwt. of gold per ton compared with 64,309 tons averaging 4.50 dwt. per ton in the preceding year.

Indeed, the increased production from Fanti played its part in enabling the company to despatch 961,662 tons to the mill — a record — and an increase of 131,042 tons over the total crushed in the preceding year, and more than 240,000 tons above the figure for 1952-53. Although the grade of ore at 3.29 dwts. per ton was slightly lower than the 3.39 dwts. ore recovered during 1953-54, the expansion in the tonnage treated more than compensated for the decline and the amount of gold produced was 149,884 ounces compared with 134,442 ounces. Accordingly, bullion revenue, less realization charges, advanced from £1,664,389 to £1,867,741. Some of this advantage, however, was swallowed in the higher total mining expenditure incurred which amounted to £1,450,888, against £1,367,138. Yet this must not be allowed to mask the fact that the overall cost per ton milled at 30s. 2d. per ton was 2s. 9d. per ton lower than in the preceding year. In any event, profits for the year worked out at £119,405 compared with £40,451 in the preceding year. Shareholders were not disappointed and two interim dividends of 5 per cent each were distributed per 3s. stock unit on the issued capital of £2,884,900. This compared with the distribution of 2½ per cent in the preceding year and absorbed a net amount of £162,275 leaving a balance of £85,683 to be carried forward.

During the year under review 16,296 ft. of development was accomplished, an increase of 7,179 ft. over the preceding year. A total of 9,150 ft. were sampled, 4,005 ft. of which proved payable averaging 7.5 dwt. per ton over a width of 39.7 in. Additionally, 3,900 ft. of raising and winzing was sampled, 2,750 ft. equivalent to 70.5 per cent of which proved payable at 7.5 dwt. per ton over 38.8 in. During the current year, ending September 30, 1956, the rate of development is again being raised to 30,000 ft. per annum. By this means it is hoped to reverse the falling trend in ore reserves which showed a fall during the year of 437,113 tons to 2,895,428 tons.

The outlook for the current year has been darkened by the

OPERATING RESULTS FOR THE GROUP'S PRODUCING MINES IN WEST AFRICA

Company	*Year Ended*	*Tons milled (000)*	*Grade (dwt.)*	*Yield (oz.)*	*Cost** per ton* s.	d.	*Bullion† Revenue* £	*Other Income* £	*Mining Costs* £	*Other Expenses* £	*Gold Duty* £	*Tax* £	*Net Profit* £	*Dividend* %	*Carry Forward* £
Amalgamated Banket Areas	30. 9.55	962	3·3	149,884	32	11	1,867,741	1,129	1,450,888	256,821	Nil	Nil	119,405	10	85,683
	30. 9.54	831	3·4	134,442	35	1	1,664,389	21	1,367,138				40,451	2½	128,674
Ariston Gold Mines ..	30. 9.55	456	6·6	132,562	49	8	1,652,768	10,053	1,065,082	198,787	18,500	174,178	206,274	10	80,297
	30. 9.54	399	7·3	130,923	52	11	1,621,436	4,758	1,020,144	172,794	27,824	235,181	170,251	30	78,710
Bremang Gold Dredging	31.12.54	6,335‡	2·42§	29,240	1	0*	363,215	6	323,860	46,491	Nil	3	—7,130	Nil	1,517
	31.12.53	6,452‡	2·51§	30,759	0	10*	394,372	3,718	271,469	36,731	Nil	1,210	88,581	Nil	20,451
Gold Coast Main Reef	30. 6.55	114	8·6	43,995	75	6	548,674	2,769	383,609	87,193	Nil	41,098	39,543	5	25,776
	30. 6.54	112	8·9	45,554	79	1	569,895	1,802	402,538	85,240	Nil	52,251	31,668	7½	16,878
Marlu Gold Mining Areas	30. 9.54	475·4	2·42	45,487	17	8	561,653	1,427	419,018	42,857	Nil	628	110,577	Nil	240,556
	30. 9.53	498·5	2·0	49,421	18	11	641,266	3,767	471,480	49,002	Nil	1,177	123,374	5	125,799

** Including development charges. ‡ Cu. yds. § Grains recovered per cu. yd. * Per cu. yd. † Less realization charges.

general strike of African employees which lasted for more than three months, commencing November 20, 1955, and ending February 27, 1956. This sobering comment is reflected in the December quarterly which revealed that the tonnage treated was only 144,415 tons as compared with 251,447 tons in the corresponding quarter of 1954,55. The grade was roughly of the same order but the yield was down to 22,693 oz. and bullion revenue dropped to £283,577 against £502,442. Mining costs, however, did not fall proportionately, and working profit for that quarter came to only £66,912 against £146,236.

The effect on the March quarter's results are likely to be even more severe, since that period will have to bear the cessation of work for almost exactly two months instead of the five weeks stoppage in the December quarter. Clearly the company will have to husband its resources for the time being ; at the end of 1953-54, net current assets stood at £480,535.

BREMANG GOLD DREDGING COMPANY LIMITED

An analysis of the quarterly reports show that Bremang Gold Dredging enjoyed a much better year in 1955 than in 1954, when it suffered a loss of £7,130. That loss was incurred because at one time two of the company's four dredges were out of action. The year 1955 opened, however, with three of the dredges in action, and the fourth was brought into operation during the first quarter of the year. During the combined second and third quarters of 1955, the output of gold amounted to 24,436 oz., a total which compares very favourably with the 29,240 oz. produced during the whole of the preceding year. The strike of African natives during the fourth quarter reduced output — one dredge was worked on a limited scale by Europeans — but even so, bullion revenue for the whole year exceeded mining costs by £120,883, as compared with £41,076. From that excess must be deducted depreciation, London office charges, taxation and gold and mineral duties. In 1954, these amounted to £46,491, and this serves as a guide to forecasting the 1955 experience. According to the quarterly reports, capital expenditure during the year came to £48,329, and if this has been wholly charged to the year's profits, there would be a surplus of roughly £25,000. This seems satisfactory and when Bremang can get into its stride again after the strike, the current year should give encouraging results, provided that the strike settlement is not too expensive.

The company is faced with the problem of transferring the two dredges remaining on the Ankobra River, one in about two year's time and the other in three years. To obtain sufficient funds to finance this expensive operation, money will probably be raised by the issue to existing holders of additional capital but in the meantime, temporary arrangements are being made.

ARISTON GOLD MINES (1929) LIMITED

Once again new records were set up by Ariston Gold Mines during the year to September 30, 1955, the 455,730 tons sent to the mill far exceeding the previous best of 398,850 tons sent in the previous year. Although the expansion programme has now reached a stage which does not permit elasticity in the extraction of ore, and the grade has consequently fallen from 7.33 dwt. per ton to 6.59 dwt., the quantity of gold recovered — 131,212 oz. — makes a new record, and bullion receipts at £1,652,768 are the highest ever achieved.

The scene seemed to be set for an even better performance during the current year. The new winder at the Central shaft gave no trouble and during the closing months of 1954-55 was running very closely to its rated capacity of 40,000 tons per month. Efforts to reduce costs continued to bear fruit in 1954-55, working costs having being cut to 46s. 10d. per ton against 51s. 2d., and even though the resumption of more normal development working raised costs for this type of work to 2s. 10d. per ton (1s. 9d.), total costs at 49s. 8d., were still well below 52s. 11d., the corresponding figure for the previous year, and 59s. 3d. for 1952-53.

These improvements continued to be mirrored in the accounts for the year : £82,079 was written off ore development expenditure, an increase of £13,587, and depreciation took another £11,245 at £89,416, but minerals duty absorbed only £18,500 (£27,824) and tax £174,178 (£235,181). Admittedly, an extra £10,000 was allocated to allow for an increased tax liability following a Court decision, but even after deducting that amount, net profits came to £196,274 as compared with £170,251.

Between the ending of the financial year and the time to consider the payment of a final dividend — 10 per cent had been paid as an interim in April, 1955 — the strike of African workers commenced. This cessation of an inflow of cash caused the board to pass the final dividend, a disappointing result for all concerned after the year's highly satisfactory results.

GOLD COAST MAIN REEF LIMITED

For the fourth successive year, Gold Coast Main Reef treated a bigger quantity of ore than in its predecessor. During the year to June 30, 1955, the increase from 112,381 tons to 114,063 tons was perhaps on the small side, but coming after the previous expansions, it was a very satisfactory achievement. Unfortunately, the improvement in the head value of the ore was not maintained, — it dropped from 9.044 dwt. per ton to 8.600 dwt. — and this reduced the amount of gold produced from 45,554 ozs. to 43,995 ozs. Consequently bullion revenue, reckoned after deducting realisation charges, was £21,221 lower at £548,674.

This might seem a disappointing result from the treatment of the bigger tonnage, but the long-standing efficiency campaign bore more fruit during the year, and total mining expenditure fell by £18,929 to £383,609. As a result working profits declined by only £2,300 or so, and although individual allocations and appropriations varied, the gross profits were only approximately £3,300 down.

At this point the tax authorities claimed their share, but instead of taking £52,251, they cut their claim to £41,098. And net profits instead of being smaller were bigger by about £8,000 — the figures were £39,543 in the latest year against £31,668. A straight comparison cannot, however, be made between the two tax items ; profits tax in 1954-55 absorbed £12,775 (£18,500), but part of this reduction came from the decision to lower the year's dividend payments to 5 per cent as compared with 7½ per cent in the previous year. Had the company made a larger payment, its liability to distributed profits tax would have been greater, and net profits lower than the £39,543 already mentioned. It seems doubtful, however, whether they would have been so low as the 1953-54 figure of £31,668, since income tax demands abated from £33,751 to £28,323.

The decision to cut the dividend, despite the apparently better results, was caused by the strike of the Native workers and the ensuing need to husband the company's resources.

Satisfactory development was reported in the Tuappim section which accounts for almost one-half of the available ore reserves ; incidentally, about one-third of the tonnage milled in 1953-54 came from this section. A great deal of the company's future depends, however, on development results at depth on the Bondaye section. It is hoped that the poor zone encountered between the 16th and 18th levels will give way to higher grade ground at the 20th level. Should that hope be frustrated serious consideration would be given to more extensive development at both Tuappim and Ekotokroo, the latter section lying to the north east of Tuappim and Bondaye, running to the border of the Ariston property.

SUMMARY OF OPERATIONS SINCE DATE OF LATEST PUBLISHED REPORT AND ACCOUNTS

Company	*Period*	*Tons milled*	*Yield (oz.)*	*Grade (dwt.)*	*Bullion Revenue* £	*Mining Costs* £	*Working Profit* £	*Capital Expenditure* £	*Available Ore Reserves as at last Published Report*		
									Tons (000)	*Value* (dwt.)	*Width* (*in.*)
Amalgamated Banket	3 months to 31.12.55	144,415	22,693	3·14	283,577	216,665	66,912	2,784	2,895·5	3·99	—
Ariston	3 months to 31.12.55	70,260	19,647	5·592	245,325	164,359	81,466	11,453	2,466·3	6·47	118·0
Gold Coast Main Reef	6 months to 31.12.55	43,036	15,374	7·145	192,433	156,184	36,249	24,617	324·3	8·54	70·9
Bremang	12 months to 31.12.55	8,221,460*	39,283	2·09†	492,088	369,452	122,636	48,329	79,657‡	2·69†	—
Marlu	In voluntary liquidation since May 26th, 1955										

* Cubic yards. † Grains per cubic yard. ‡ Thousand cubic yards.

Ashanti Goldfields Corporation Ltd.

TO begin this article by stating that Ashanti Goldfields Corporation passed its final dividend thereby leaving shareholders with only one interim dividend of 20 per cent per 4s. unit on the one-class issued capital of £1,248,557, is very much like peeking at the last page of a mystery thriller to find out "whodunnit". Before proceding with the task of clarifying this unpleasant but necessary fact it is essential to say at the outset that the company's latest financial year ended on September 30, 1955; that operations during that period were, in almost every respect, wholly satisfactory; that the outlook for Ashanti seemed assured; and finally that an ample labour force was maintained throughout the year which was free from disputes.

DIFFICULT LABOUR SITUATION

But the labour situation on the Gold Coast has always been somewhat tricky. Not that this applies in any particular way to Ashanti. On the contrary, those who have received the latest report and accounts will clearly see from the illustrations contained therein, the excellent living conditions the Corporation has provided for its labour force. In fact, the Corporation has always placed a premium on loyalty and in times of stress this policy has brought its just rewards.

Unfortunately, there are still a number of Africans who are subject to a degree of intimidation difficult for Europeans to fully appreciate. And this, together with the fact that the Mines Workers' Union pursues an irresponsible policy believing, as they do, that their prime function is to obtain higher wages for their members regardless of economic conditions, creates, at times, an extremely difficult labour situation.

An opportunity to create such a situation has long been smouldering in the Gold Coast. Towards the end of 1954 the Mines Workers' Union demanded a 15 per cent all round increase in wages based on an alleged rise in the cost of living. Although this was later proven false, thus ending the threat of a strike, the agitation of the Union still persisted.

Despite the fact, as aforementioned, that an ample labour force was maintained throughout the year ended September 30, 1955, a warning of things to come was given on September 27, when the Union forced a strike for two weeks in an effort to effect a change in the methods of paying out wages. This dispute was settled on October 11, but less than six weeks later — November 20, 1955, to be precise — a second strike began when the African labour stopped work at all the gold mines in the colony as well as the bauxite and diamond mines. This was in fact a continuation of the former grievance calling for an increase of 15 per cent in wages. But this time the demand also included the rider that it should be back-dated for two years. Needless to say, the gold mining industry with a fixed price for its product, cannot pass on rising costs, and thus resisted these demands with success although the victory may yet prove to have been Pyrrhic. In any event the *status quo ante* was reached on February 27, 1956, when the men returned to work on the same conditions as had obtained before the strike. Meanwhile, a Board of Inquiry, formed to investigate and report on the strike, started sitting on January 2. Hearings were completed on February 9, but at the time of going to press no report has been published.

How much harm alike to the Union and to the mining industry has been caused will probably never be known. But one mine has been forced to cease operations, and although Ashanti — because of the steadfastness of its European employees — was able to announce a small profit, subject to tax, of £35,839 for the six month period ending March 31, 1956, this figure in its proper perspective must be compared with a profit of £419,672 earned in the comparable six month period ended March 31, 1955. The drain on the company's cash resources can be well imagined, and for this reason the final dividend had to be passed in respect of the year ended September 30, 1955.

Nevertheless, the year under review, was a prosperous and satisfactory period for Ashanti in almost every respect. The qualification "almost" is used because an experiment tried for eliminating the drying and roasting of flotation concentrates before cyanidation was unsuccessful and had to be abandoned but not before the percentage recovery of gold extracted from the ore dropped appreciably. In much the same context the company experienced difficulties with the treatment of surface ores for a short time, and the combined effect of these two adversities was reflected in a decrease in recovery to 87.4 per cent from 90.4 per cent in the preceding year. Apart from this minor setback, however, results were good. Gold production increased to 196,236 oz. compared with 192,494 oz., and an impressive feature was the paring down of working costs to 69s. 4d. per ton against 71s. 6d. per ton, and of development costs to 13s. 6d. compared with 14s. 4d. Tax liabilities were also less — £377,000 against £446,000 — so that net earnings were roughly £120,000 higher at £460,000. Thus there was every reason to hope that the preceding year's distribution of 40 per cent would be maintained.

THE REAL COST OF THE STRIKE

However good the financial results may be considered, or however disappointed shareholders may be with the necessity to halve the dividend, the real blow alike to shareholders and the mine management from the strike, has been the loss of time in which to continue with the underground reorganisation of the mine.

In recent years, the long term future of the Ashanti mine has been closely linked with the opening up of the mine at depth, the centrepiece of which was the sinking of the Eaton Turner Shaft to its final depth of 4,354 ft. This is so because until the Eaton Turner Shaft was completed, it was not possible effectively to exploit the unusually rich high-grade ore already proven lying at the lower levels at the north end of the mine.

During the year ended September 30, 1955, the Eaton Turner Shaft was sunk a further 1,201 ft. and reached its final depth of 4,354 ft. in August. Between that date and the outbreak of the strikes, excellent progress was being recorded but work, of course, came to a standstill on November 20. The present position is, therefore, that shaft stations have been formed and connections established with levels 32 and 35, and insets have been installed at the horizons of levels 38, 40, 41 and 42. The excavation for a skip loading pocket at level 42 has been completed.

While first priority is now being given to equipping the Eaton-Turner Shaft, much remains to be done, and it is doubtful whether this important task can be completed before the end of September, which means that the development of the bottom of the mine will be delayed further.

Even though it is necessary to be reserved about the future outlook for Ashanti in the current year, the longer term outlook is undeniably bright. Yet, in spite of the rather sad contrast between the earnings for the first six months of the current financial year and those earned in the same period of the preceding year — a matter of £36,000 against £420,000 — there are hopes that the position may be retrieved to some extent. In this connection plans are now in hand to effect a larger tonnage throughout of high grade ore than would be deemed sound mining practice in more normal circumstances. This policy will, of course, be confined to a limited period and in any event should not seriously affect the mines resources.

Meanwhile, much good work has been done during the year towards improving conditions and underground efficiency generally. In particular, stoping practice has been under scrutiny and efforts are being directed towards introducing methods allowing for a higher degree of mechanisation, reduction in labour and in the use of timber, and to simplify ventilation in the stopes.

OPERATING RESULTS

Year to Sept. 30	*s. tons milled (000)*	*Grade (dwt.)*	*Yield (oz.)*	*Cost* per ton s. d.*	*Bullion† Proceeds £*	*Other Income £*	*Mining Costs £*	*Other Costs £*	*Taxation§ £*	*Free Balance £*	*Dividend %*	*Pension Fund £*	*To Reserve £*	*Ore Reserves*	
														Tons (000)	*Grade (dwt.)*
1955	310·9	14·45	196,236	69 4	2,466,101	33,579	1,288,056	234,287	500,892	476,445	20	17,108	315,753	2,021·7	16·1
1954	297·7	14·36	192,494	71 6	2,374,823	41,615	1,278,420	216,047	568,355	353,616	40	16,609	62,325	2,212·9	16·2
1953	281·0	14·4	180,218	69 5	2,343,234	31,189	1,151,401	199,633	684,716	338,673	40	16,400	47,591	1,408·4	19·0
1952	226·9	16·2	165,913	70 9	2,165,843	32,348	967,586	175,713	718,127	336,765	50	14,218	34,772*a*	1,410·4	18·8

* Excluding development charges. † Less realization charges. ‡ Depreciation and general expenses. §Including Gold Coast Government Royalty and Gold duty.
a Taken from reserve.

For example, rill stoping is being used where reef conditions are favourable, and one large block on No. 12 level at Ayeinm, is being opened up for sub-level mining. Generally speaking the underground workings are in good condition and the standard of new work is excellent.

With every effort bent towards completing the Eaton Turner Shaft, development work, quite understandably, during the year to September 30 last, was restricted and much of the footage advanced was not expected to produce new ore. Nevertheless No. 20 level on the Cote d'Or Reef was extended 341 ft. southwards and values were exposed over a length of 250 ft. averaging 14.8 dwt. over a width of 32 ft. The south end of this shoot has not yet been reached, nor has any development been possible to prove its extension below No. 20 level, although a winze is in course of preparation for this purpose. The only other interesting development work was carried out on level 25 where, from the work of proving the orebody, 26,412 tons averaging 23 dwt. were added to ore reserves.

In this latter connection ore reserves at all sections of the mine — Ashanti, Ayeinm and Justices — declined to a total of 2,021,674 tons averaging 16.2 dwt. gold per ton, compared with 2,212,884 tons averaging 16.2 dwt. a year earlier. The ore reserve position is, however, still strong, being equivalent to approximately 6½ years supply to the mill on a monthly throughput of 26,000 tons. Moreover, ore reserve values could very quickly recover both in quantity and quality once ore from the bottom of the mine is contributing to reserves as values already disclosed there have been exceptionally high.

Bibiani (1927) Ltd.

IN recent years, the mining policy of Bibiani has been to maintain its ore reserve position and concentrate on development work directed towards locating and developing new ore, additional to the South shoot, in depth. It may, perhaps, be recalled that it was not so long ago that the Central and South orebodies, which had provided the bulk of the tonnage for the mill, were pinching out on levels 11 and 12 and the decision was taken to accelerate development at depth as quickly as possible where the South shoot was intersected on level 15. Development work at Bibiani has, therefore, been concentrated on proving the South orebody, below level 15. The present position is that it has been proven down to level 19 where values have been exposed over a length of 600 ft. Ore proved on this shoot has been in the region of 120,000 tons per level. But on this basis, it would be necessary to develop at least two levels per year to ensure continuity of the present rate of production if no other orebodies are developed and other resources become depleted.

As yet, unfortunately, there is no indication of any major payshoots developing below level 12 of the Central and Northern orebodies which formerly provided such a large proportion of the output from the upper levels. During the year ended September 30, 1955, information gained from limited exploration work carried out north of the Central Shaft on levels 15 and 18 — although not conclusive — does not encourage that view that a major orebody is likely to be developed on these horizons.

That being so, it has become most urgent that exploration in depth should be accelerated, and the immediate programme is to develop levels 20 and 21 on the South shoot and to drive northwards on level 24. Complementary to this exploration activity has been the work of extending the internal shaft and to bring into use the skip loading pocket between 24 and 25 levels. In fact, the internal shaft during the year under review was extended a distance of 511 ft. to 5 ft. below level 25.

MIXED DEVELOPMENT RESULTS

During the year under review, 21,633 ft. were developed compared with 19,101 ft. in the preceding year. The resultant values were mixed. On the upper levels — Nos. 2, 10, 11 and 12 — exposures of new ore were encouraging. But on levels 15 and 18 drives on which have been covered distances of 1,750 ft. and 1,650 ft. respectively north of the Central shaft results were indeterminate. On level 2, however, payable ore was exposed over 150 ft. averaging 7 ft. in width with a value of 7.6 dwt. gold per ton between crosscuts 30 North and 33 North. Between crosscuts 37 and 42 North, on the same level, a further 250 ft. were driven averaging 5 dwt. over a width of 12 ft.

No. 10 level was extended 368 ft. and ore, averaging 5 dwt. per ton over a width of 10 ft. was proved, for a distance of 150 ft. which has increased the total length of this ore shoot to 700 ft. averaging 6.4 dwt. over a width of 10 ft. Slightly better results were achieved on level 11 where ore averaging 6 dwt. per ton was exposed over a length of 400 ft. with an average width of 8 ft., and also on level 12 where 100 ft. of ore exposed gave payable values, averaging 6.75 dwt. over a width of 20 ft.

A further incentive to the company to continue its development work with all possible speed is its ore reserve position. As mentioned earlier in this article the company's policy in recent years has been to maintain its ore reserve position and in this regard it has been successful over a number of years. But at the end of September 1955, a recalculation of the ore reserves showed the position to be that the tonnage available amounted to 1,481,048 valued at 5.6 dwt. per ton. While this represents over four years supply to the mill at the monthly crushing rate of 30,000 tons, it does not compare favourably with the preceding year's figures of 1,783,533 tons valued at 5.47 dwt. gold per ton.

In addition to the work at depth in the south orebody, arrangements have also been made for carrying out an intensive programme of prospecting the surface to the north of the present underground workings.

REDUCED WORKING COSTS

Not all the news from Bibiani is of such a sober character. An impressive performance has been the reduction in working costs per ton mined by 3s. to 38s. 8d. per ton. This is the first time in nine years that working costs have been lowered and this played its part in enabling the company to earn net profits, after a lower tax charge, of roughly £80,000 against £67,000 in the preceding year. But, as with its sister company, Ashanti, the strike, by reducing the company's liquid resources, caused the final dividend to be passed thereby leaving shareholders with an income from the interm distribution of 5 per cent per 4s. unit on the one class issued capital of £500,000 compared with the payment of 10 per cent for 1953-1954.

Like Ashanti, the year's results would most certainly have merited the maintenance of the preceding years dividend if the strike had not taken place. Indeed, the balance sheet position at the end of September last was reasonably healthy. Current assets at that date totalled £688,145 or almost £70,000 more than in the previous year. Of this total, stores and plant represented £331,218 and British Government Treasury Bills £198,045. Current liabilities at £229,886 were also higher, but only topped the 1954 total of £211,300 by £18,586. In any event net current assets advanced to £458,259 against £408,193 which may be compared with the total issued capital of £500,000.

The outlook for the current year is not good. During the first six months to March 31, 1956, a loss estimated at £77,570 was incurred owing to the strike.

This may be compared with a profit of £85,734, subject to tax, in the comparable period of the year under review. Unfortunately, too, Bibiani is not in the same position as Ashanti to retrieve the position by undertaking selective mining so that the best that can be looked for, perhaps, is that the mine will break even when the financial year ends next September.

OPERATING RESULTS

Year to Sept. 30	*s. tons milled (000)*	*Grade (dwt.)*	*Yield (oz.)*	*Cost* per ton s. d.*	*Bullion† Proceeds £*	*Other Income £*	*Mining Costs £*	*Other Costs £*	*Taxation‡ £*	*Free Balance £*	*Dividend %*	*Staff Assurance Fd. £*	*To Reserves £*	*Ore Reserves Tons (000)*	*Ore Reserves Grade (dwt.)*
1955	366·6	4·4	75,414	38 8	946,459	10,029	708,956	93,662	66,500	79,935	5·0	7,435	65,560	1,481·0	5·6
1954	350·6	4·8	77,818	41 8	958,763	10,163	729,940	91,001	74,694	67,018	10·0	6,273	39,518	1,783·5	5·4
1953	362·6	4·5	75,005	40 9	970,874	3,298	740,937	95,626	63,000	67,365	10·0	7,244	39,865	1,782·7	5·5
1952	363·3	4·4	71,440	37 8	921,842	4,666	685,192	81,329	52,050	99,757	17·5	8,180	42,170	1,766·2	5·4

* Including development charges. †Less realization charges. ‡ Including gold duty paid to the Gold Coast Government.

The "120" Group of Nigerian Tin—Columbite Producers

IN many ways, Nigerian tin-columbite producers are a good deal better off than those in other tin-producing countries. Politically there is less cause for concern as regards the future, while the excavation and hydraulicing methods of production used are economically more flexible than those of dredging or lode mining. While costs of production naturally vary considerably from mine to mine, for the majority they are at a level which under foreseeable conditions would permit mining operations to be conducted at a satisfactory profit. The probable introduction of the International Tin Agreement — and output restrictions it may in due course bring — can, therefore, in such cases be faced with confidence.

For the same reason, the recent fall in the columbite price from over £2,000 per ton to under £1,000 per ton — which followed the termination of U.S. Government stockpiling contracts — is perhaps not so serious an event as it might have been under more highly capitalized mining operations although doubtless in the short term, some difficulty may be encountered in effecting sales of total output.

GOLD AND BASE'S GOOD RESERVES

During the past four years, Gold and Base Metal Mines of Nigeria Ltd. has undertaken a substantial programme of capital expenditure to enlarge and develop its tin-columbite properties in Nigeria. Funds for the scheme have been obtained by advances of some £240,000 from the U.S. Government (repayable by December 31, 1956, by way of columbite deliveries at prices over £2,000 a ton) and increases in share capital from £350,000 to £770,000. While this programme has caused considerable financial strain, especially as regards repayment of such loan, and entailed some reduction in dividend, it should be of great benefit to future years' operations.

Apart from U.S. loans — repayment of which will shortly be completed — the sums of money invested by Gold and Base in its development programme have been extremely large. Yet profits earned from columbite sold at bonus prices should have already gone some way towards amortizing outlays made. In the event of the I.T.A. being introduced, apart from tin operations which should continue to be profitable, the recovery of columbite would represent valuable additional earning potential.

Gold and Base's total production of tin concentrates and columbite during the financial year ended December 31, 1954, was 510 l. tons and 150 s. tons respectively. This compared with 552 l. tons and 93 s. tons for the previous year. Total F.A.S. costs for tin fell to £503 from £547 while those for columbite rose steeply to £963 from £764, but this latter was due mainly to an increase in royalty to £371 per s. ton.

Total revenue earned moved up sharply to £589,315 from £476,085 and the previous year's dividend of 7½ per cent was maintained on the issued ordinary capital of £600,000 in stock units of 2s. 6d. The company's Balance Sheet at December 31, 1954, showed total assets at £1,387,732 against £1,364,714.

Output of tin concentrates during 1955 increased to 582 l. tons, while columbite production at 183 s. tons fell just short of the 200 s. ton target for the year, largely owing to a strike of seventeen days in October/November 1955. In view of the favourable price of tin received, and the fact that the Company will have sold its columbite output to the U.S. at bonus prices under contract, financial results for the year should be better than those of 1954. However, the incidence of loan repayments to the U.S. Government will have reached its peak and this may influence the dividend distribution policy.

The outlook for 1956 is not so clear. During the first four months production has totalled 198 tons of tin concentrates and 56 tons of columbite. How much of the current year's production of columbite is due to be delivered at the bonus price to complete the outstanding commitments under the U.S. contracts is not known. Concentrates not included under these contracts will, of course, have to be sold on a somewhat difficult open market, although a lower price will incur substantially lower royalty payments.

UNITED TIN'S NEW AREAS

Since its financial year ended June 30, 1955, United Tin Areas of Nigeria has been fortunate enough to dispose of its uneconomic Gurum Leases for a price of £12,000. At the same time, the company had acquired from Fobra Tin its assets and ground at Odegi, Benue Province, Northern Nigeria, and further strengthened its position by taking an interest in other leases also in the Odegi area adjacent to those previously owned by Fobra. The area thus formed comprises a compact and easily worked block of tin-columbite bearing ground, in which Ribon Valley (Nigeria) Tinfields Ltd. hold a one-third interest.

United Tin's total assets at June 30, 1955, amounted to £317,286. Included in this figure was an entry of £35,422 for quoted investments which represent the company's holding in The Esperanza Copper and Sulphur Company.

Production during the year ended June 30, 1955, amounted to 140 l. tons of tin concentrates compared with 93 l. tons previously. Reflecting the acquisition of its new areas, the company's columbite output expanded to 42 s. tons from only 1½ s. tons during the preceding twelve months. Total revenue advanced to £167,785 from £52,027 and a dividend of 7½ per cent was paid on the issued capital of £150,000. No distribution was made in respect of 1953-54.

Production of tin concentrates during the first nine months of the current financial year ending June 30, 1956, has fallen to 89 l. tons from 114 l. tons during the previous corresponding period. But columbite recovery has expanded to 56½ s. tons from 33½ s. tons.

EX-LANDS' EXPANSION DELAYED

Recently the Ex-Lands Nigeria has made great strides towards mechanizing its mining operations. Serious delays have, however, been experienced in bringing a most important item of new equipment — a 230 ton capacity Monighan Dragline — into production. This has delayed the projected expansion of output, but it should not now be long before the dragline starts work.

Due to the efficiency of its methods, the compact nature of its mining areas and the high grade — averaging .92 lb. of tin per cu. yd. — at its disposal, Ex-Lands is one of the lowest cost producers in Nigeria and perhaps in the world. During the year ended December 31, 1954, a total of 610 tons of cassiterite were produced at an F.O.R. cost of only £252 per ton. This compared with 646 tons at a cost of £238 in respect of the previous year. Revenue earned, however, increased to £328,993 from £319,045. A dividend of 20 per cent was paid on an issued capital of £274,108, in stock units of 2s. Distribution for 1953 totalled 20 per cent on the previous capital of £200,000.

So far, in the absence of contributions from the new dragline, production during the first four months of 1956 at 208 tons of tin concentrates has shown little change from that of the previous corresponding period of 1955 which amounted to 234 tons.

BISICHI'S HIGHER OUTPUT

A capital expenditure programme has been in progress at Bisichi Tin Company (Nigeria) over the past two years with the object of stepping up output — particularly that of columbite — and improving mining extraction efficiencies. This plan has involved expenditure of nearly £213,000 but increasing outlays are now practically at an end and output figures are demonstrating the success of the project. Bisichi is a low cost and compact producer with easily obtainable supplies of water and power.

During the year ended December 31, 1955, output of tin concentrates and columbite amounted to 682 l. tons and 318 s. tons respectively. This compared with 633 l. tons of tin concentrates and 302 s. tons of columbite produced during 1954. Combined F.O.R. costs for the year totalled £329½ per ton compared with £285¾ per ton during 1954.

Bisichi's total revenue for the year ended December 31, 1955 at £944,558 compared with £744,212 for the previous year. Net profits after taxation amounted to £139,362. Dividends on the issued capital of £460,000 in 2s. 6d. shares was 40 per cent (against 50 per cent in 1954) leaving an amount of £121,467 carried forward to the credit of Profit and Loss Account. So far operations during the first four months of the current year have resulted in a production of 271 l. tons of tin concentrates and 112¾ s. tons of columbite. The Chairman, in his annual review, stated that columbite, surplus to contractual obligations, was being sold at a satisfactory profit. Since the close of the financial year the Bisichi Company has purchased further properties in Nigeria to augment its ore reserves.

Kaduna Syndicate Limited

ONE of the problems facing Kaduna Syndicate during the past few years has been a declining ore reserve position. It was, therefore, most encouraging that during the financial year ended December 31, 1954, the working of certain portions of reserves indicated the presence of 370 tons of ore over and above the original estimates. It has, however, been decided not to include this probable excess in declared reserves, but to hold it against shortages which might arise in future.

RISING PRODUCTION

Greater production during 1954 reflected a much higher average grade of ground handled than that of the previous year. But while at .82-lb. of tin per cubic yard average yield showed a substantial gain over .66-lb. obtained in 1953, the improvement was due to high values recovered from the stripped hill deposit which has since become worked out. In the future tin content must, therefore, not be expected to run at this exceptional level.

Year to Dec. 31	*Output (tons)*	*Sales (tons)*	*Per ton Ore (price)*	*(cost)*	*Tin Sales*	*Ore Reserves (tons)*
			£	£	£	
1954	332	340	511	196	173,667	622
1953	327	345	506	232	174,510	775
1952	271	225	687	272	154,503	1,101

An interesting feature of the year's operations was the sharp drop in costs to an extremely low level. While this was due to the smaller volume of ground treated, it also emphasizes the substantial profit margin on which the company is able to operate. This is worth bearing in mind, particularly in view of the almost certain introduction of the International Tin Agreement. Under the scheme Kaduna Syndicate's quota output would be restricted to about 293 tons.

Of the total production during 1954, 241 tons came from ore reserves while 91 tons was drawn from outside sources. This was an improvement on the 1953 figures of 246 tons and 81 tons respectively.

Low costs incurred during the past financial year were directly responsible for the company's net profit being more than doubled. In consequence distribution was able to be substantially increased.

Year to Dec. 31	*Gross Revenue*	*Total Expenses**	*Taxation*	*Net Profit*	*Dividends (net)†*		*Carry Forward*
	£	£	£	£	%	£	£
1954	176,568	115,065	34,380	27,123	66⅔	18,100	11,729
1953	177,937	142,950	21,765	13,222	50	13,200	12,764
1952	159,126	103,905	34,700	20,521	75	19,500	12,651

* After adjusting for opening and closing stock. 1954—Dr. £5,812; 1953—Dr. £15,883; 1952—Cr. £20,854.

† On issued capital of £48,000.

In order to provide against the possibility of a contribution having to be made to I.T.A. buffer stocks—equivalent to about 32 tons of tin metal of which not less than 25 per cent. would be payable in cash at £640 a ton—the company transferred £10,000 from profit and loss account to general reserves. This account was thereby increased to £20,000.

The return to a more normal grade of ground worked was responsible for a decrease in production to 241¼ tons of tin concentrates during 1955. But financial results—as indeed ore reserves—should have benefited from the good tin prices which prevailed throughout the year. Yet the interim dividend of 16⅔ per cent. which has so far been paid represents a reduction of 8⅓ per cent. from the previous year's level of distribution. One of the reasons for this could have been a sharp rise in costs resulting from an increase of wage rates on the minefield, introduced at the end of 1954 by an Arbitration Tribunal. While this award affected all grades, the greatest percentage of extra payments occurred at the bottom grade of the unskilled labour.

The first four months of 1956 have witnessed an improvement in production to 146 tons from 106 tons during the previous corresponding period of 1955.

Kaduna Prospectors Limited

AFTER many years of profitable operations, the inexorable rise in costs of wages and materials and consequent depletion of lower grade ore reserves is bringing Kaduna Prospectors to the end of its economic life. As only one tin bearing area now remains to be prospected—from which results so far have been definitely disappointing—the future is viewed with considerable anxiety.

At December 31, 1954, Kaduna Prospectors' ore reserves represented less than two years' production at a rate of 70 tons of tin concentrates a year. Yet so long as there appears to be a prospect of earning profits without depleting its financial assets, Kaduna Prospectors has decided that operations will continue. This decision will certainly appeal to shareholders whose future hopes will naturally be centred around an eventual return of capital.

Indeed, at December 31, 1954, Kaduna Prospectors' balance sheet indicated that such a possibility was entirely practicable. Total assets at £36,963, of which nearly £34,000 was in liquid form, compared with an issued capital of only £20,000. Without, therefore, taking into account the possible value of fixed assets and trade investments which were shown at £3,200, a sum of about 2s. 6d. a share appeared to be immediately available for break-up. This figure, of course, takes no account of future surpluses which may be earned by the company during its remaining years of operative life.

Year to Dec. 31	*Output (tons)*	*Sales (tons)*	*Per ton Ore (price)*	*(cost)**	*Tin Sales*	*Ore Reserves (tons)*
			£	£	£	
1954	70	70	521	313	36,478	112
1953	116	120	499	250	59,908	153
1952	77	75	688	332	51,615	247

* Computed on f.o.r. basis.

During the past financial year, following the exceptional 1953 output, production reverted to a more normal level.

Although falls in production during 1954 were general, the biggest drop occurred in respect of the Werran Areas. The average grade of ground worked apart from tribute tin and the re-treatment of tailings was only .51-lb. per cubic yard against .68 previously.

Year to Dec. 31	*Gross Revenue*	*Total Expenses**	*Taxation*	*Net Profit*	*Dividend† Distribution*		*Carry Forward*
	£	£	£	£	%	£	£
1954	37,146	30,300	4,123	2,723	25	2,833	3,079
1953	61,126	50,844	6,985	3,297	33⅓	3,667	2,745
1952	52,638	39,160	9,800	3,678	33⅓	3,604	2,990

* After adjusting for opening and closing stocks. 1954—Cr. £1,680; 1953—Dr. £4,870; 1952—Cr. £1,960.

† On an issued capital of £20,000.

In view of the possibility of having to contribute the equivalent of approximately 8.7 tons of tin metal to the International Tin Agreement buffer stock, of which not less than 25 per cent. is payable in cash at £640 per ton, the company considered it prudent to increase the general reserve to £6,000 by a transfer of £1,000 from profit and loss account.

IMPACT OF HIGHER WAGES

Towards the end of 1954 an Arbitration Tribunal made an award giving wage increases in nearly all grades of labour. The biggest of these was in the bottom grade of unskilled workers. Accordingly, the full effect of these increased costs have been felt during 1955 and it has been due to this, together with the fact that production has fallen to 63¼ tons, that the company has decided not to declare an interim dividend. But this does not imply that no payment will be made, for, in June—at which time the accounts are due to be published—the year's distribution will be announced. The first four months of 1956 have shown no tendency towards increased output. So far tin concentrates produced at 16 tons compared with 24 tons during the previous corresponding period of 1955.

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The British Petroleum Co. Ltd.

THE British Petroleum Company's first year under its new name has been one of continued progress in its world wide interest.

The company's search for oil has been extended to five further countries. In France, the D'Arcy Exploration Company, B.P.'s prospecting subsidiary, holds a 30 per cent interest in Société des Pétroles de Valence, which has obtained exploration licences in the Isère department on the western edge of the Alps. In Africa, exploration permits have been obtained in Libya and Gambia. In the southern Red Sea, exploration will take place in the British administered Kamaran Islands, north of Aden; and in New Zealand, B.P. has entered into an exploration agreement with the Shell Group and Todd Brothers Limited. Exploration work also continues in Sicily and Malta, and in partnership with the Shell Group in Nigeria and East Africa.

In Australia, Papua and Canada, exploration work is carried out in association with other international interests. In Trinidad, where B.P. has a one-third interest in Trinidad Northern Areas Ltd., the off-shore well in the Gulf of Paria is still testing, and in the Cape Fortin area production has been obtained from nine deviated wells drilled from the shore. In the Persian Gulf, a further survey of the sea bed, preliminary to marine drilling, is to be carried out off the Trucial Coast in association with Compagnie Française des Pétroles.

In the United Kingdom, D'Arcy Exploration Company discovered in May, 1955, a new oilfield at Egmanton, Nottinghamshire, six miles from the established oilfield at Eakring. At Plungar, also in Nottinghamshire, where oil was first discovered in 1953, development of the field continues. At Nocton in Lincolnshire, where five wells were completed during the war, a sixth is now being drilled. B.P.'s production of crude oil in the United Kingdom in 1955 amounted to 53,000 tons. The search for natural gas, which the D'Arcy Company is undertaking on behalf of the Gas Council, continues in many parts of the country including Yorkshire, the Cheshire Basin, Northumberland and Durham.

SOURCES OF CRUDE OIL SUPPLY

British Petroleum's sources of crude oil supply include a half interest in the Kuwait Oil Company whose production in 1955 reached 53,900,000 tons compared with just under 47,000,000 tons in 1954. For the second year running, Kuwait has been the biggest producer in the Middle East. Supplies also derive from a 23½ per cent interest in the Iraq Petroleum Company, whose production in 1955 amounted to 24,200,000 tons compared with 23,700,000 tons in 1954; and in the Basrah, Mosul and Qatar Petroleum Companies whose total production in 1955 was 13,900,000 tons, compared with 10,600,000 tons, in 1954. In Persia, where B.P. is a 40 per cent partner in the consortium of companies operating the oil industry, production in 1955—the first full year of working under the new agreement—amounted to 15,772,000 tons.

The capacity of the fourteen refineries, in nine countries, operated by B.P. or its subsidiary and associated companies, will soon be increased by just over 9,500,000 tons. At Kent refinery on the Isle of Grain, a new expansion scheme is planned which will raise capacity from the present 4,500,000 tons to 7,000,000 tons a year. Plant and services, which are being added, are expected to be completed in 1957/1958. In Kuwait, an important programme has been announced, of extensions to Kuwait Oil Company's refinery at Mina al Ahmadi, which will increase capacity from 1,400,000 tons to 8,500,000 tons a year. Two distillation units are to be added, storage tanks, and equipment for increasing refinery services, such as power, steam, and water supply. Work will begin in the second half of 1956, and is expected to be completed towards the end of 1957.

The expansion at Kent refinery is additional to two other developments there. An agreement has been signed with the South-Eastern Gas Board for the erection of plant at the refinery, for the production of town gas wholly from oil products. Kent refinery is also to install plant for the production of about 130,000 tons of aviation gasoline a year, and it is expected to be in operation by 1958.

At Grangemouth refinery in Scotland, extensions have been made to the Gas Bottling plant, and in South Wales a new coastal tanker jetty has been completed for the Llandarcy refinery.

EXPANSION OF OVERSEAS REFINERIES

In France, at Lavera and Dunkirk, the two refineries operated by B.P.'s French associate Société Française des Pétroles B.P., have capacities of 2,200,000 tons and 2,000,000 tons a year respectively. At Dunkirk a bitumen plant, to be commissioned in 1956, will have a daily capacity of 500 to 700 tons. In Belgium, the Antwerp refinery, owned jointly by B.P. and Petrofina, has a capacity of 2,700,000 tons a year. A catalytic cracking plant was commissioned in May, 1955, with a capacity of 500,000 tons a year. The first platforming unit in Italy was commissioned in 1956 at Porto Marghera refinery, Venice, owned jointly by B.P. and Azienda Generale Italiana Petroli. The plant has a capacity of 80,000 tons a year and produces a high grade motor spirit component. It is the seventh platformer to be built for refineries in the B.P. Group. At Hamburg, the refinery operated by B.P.'s German associate, B.P. Benzin- und Petroleum-G.m.b.H., has commissioned plant to produce 50,000 tons a year of butane and propane gas. At Kwinana refinery, Western Australia, the first hydrofiner to be built at a B.P. refinery came into operation in May, 1955. This plant removes sulphur from gas oil, and similar plants are to be built at Kent and Hamburg refineries.

In the United Kingdom there has been considerable expansion in the production of petroleum chemicals. Early in 1955 a new company, Grange Chemicals Ltd., was formed by British Petroleum Chemicals Ltd. and the Oronite Chemical Company of San Francisco, for the production of dodecyl benzene, used in the manufacture of high quality synthetic detergents. This plant, at Grangemouth, came into operation at the end of the year. Forth Chemicals Ltd., also of Grangemouth, formed in 1950 by British Petroleum Chemicals and Monsanto Chemicals Ltd., for the manufacture of monomeric styrene required by the plastics industry, is doubling its capacity. Early in 1956, the name of British Petroleum Chemicals, owned jointly by B.P. and The Distillers Company Ltd., was changed to British Hydrocarbon Chemicals Ltd., It was announced in June, 1955, that the company's plant was to be extended to increase both quantity and range of products.

SHIPPING, MARKETING AND RESEARCH

The British Tanker Company, British Petroleum's shipping organisation, took delivery of two new vessels in 1955. At the end of the year the fleet was composed of 146 vessels totalling 2,039,432 deadweight tons.

Five tankers totalling 114,563 deadweight tons were delivered during the year to Société Française des Pétroles B.P., and two vessels totalling 65,000 d.w.t. are on order. In October the British Tanker Company announced that orders had been placed for 23 new vessels totalling 836,000 d.w.t. including six tankers of 42,000 d.w.t.

Marketing of B.P. products is carried out by various subsidiary and associated companies. In New Zealand, the Government holding in The British Petroleum Company of New Zealand has been purchased by B.P. The company, now a wholly-owned subsidiary, markets oil products in New Zealand.

At B.P.'s Research Station, Sunbury-on-Thames, extensions are being made which include a laboratory, with a chassis dynamometer room, for testing motor fuels. A team of scientists, which last autumn went to Algeria to test the performance of petrol and engine oils in high atmospheric temperatures, carried out further tests early in 1956 in Sweden, to study performance in temperatures as low as minus 40 degrees Fahrenheit. In 1956 and 1957 B.P. products will be used as far afield as Antarctica, since the company is contributing all petroleum products, including ship's bunkers, required by the British Transantarctic Expedition.

In January, 1956, the Company announced that Lord Strathalmond would retire from the Chairmanship on March 31. As Sir William Fraser, he had been one of the leading figures of the world petroleum industry for more than 20 years before being raised to the peerage in the 1955 New Year Honours, and in March completed 33 years' service as a Director of the Company, for 28 years of which he was Chairman or Deputy Chairman. He is succeeded by Mr. Basil R. Jackson, who joined the Company in 1921, and has been a Managing Director since 1949, and Deputy Chairman since 1950.

The Consolidated Zinc Corporation Ltd.

THE Consolidated Zinc Corporation was formed in 1949 to amalgamate the interests of the Imperial Smelting Corporation in the United Kingdom with those of The Zinc Corporation, Ltd. which engages in lead-zinc-silver mining in Australia. Although The Consolidated Zinc Corporation is a young organization the important Australian member, The Zinc Corporation, Ltd., has been in existence 50 years, having been formed on September 9, 1905, to treat the large dumps of zinc-bearing tailings which had accumulated from previous mine workings at Broken Hill. It was not until 1911 that the mineral leases which furnished the basis of the present mining activities were acquired. During the following year the first commercial selective flotation process was developed in this company's treatment plants and throughout its history the Zinc Corporation mill has contributed to many significant advances in the field of non-ferrous ore concentration.

Also in the Consolidated Zinc Corporation Group is New Broken Hill Consolidated Limited, formed in 1936 to develop the southern extensions of the orebodies in the Zinc Corporation leases and the combined production of the two mines is now over a million tons of ore annually.

The half-century which has passed since the establishment of the Zinc Corporation "retreatment plant" has witnessed the rapid growth of the major mining organization which forms the Australian basis of this Commonwealth group. The success with which early problems were met and overcome has led to continued advancement and kept the group's mines well to the fore of modern practice and conditions. Electric winders of up to 2,600 h.p. with winding speeds of 1,000 to 2,000 ft. per minute are installed and the workings are ventilated by an axial flow fan capable of exhausting 900,000 cu. ft. of air per minute from the mines. During 1955 New Broken Hill Consolidated completed construction of extentions to its mill, increasing the capacity to over 2,000 tons per day. As part of a programme designed to evolve means of rendering economic the mining of large tonnages of ore in the lower grade sections of the orebodies experiments in bulk ore extraction methods are being carried out on both mines. Through active research and careful attention to mining practice, technical progress and the betterment of the miners' conditions are assured.

As a result of the progressive expansion of operations at Broken Hill, power demands by the mines have increased rapidly and besides drawing electricity and compressed air from the station of Western New South Wales Electric Power Pty. Ltd., in which company the Group has a 32 per cent interest. Consolidated Zinc Corporation operates a power station of 16,500 b.h.p., generating capacity through a wholly owned subsidiary The Southern Power Corporation Pty. Ltd.

The bulk of the timber for the mines is supplied by Heron's Creek Timber Mills Pty. Ltd. another member company of the Group which owns forest areas and saw mills in New South Wales.

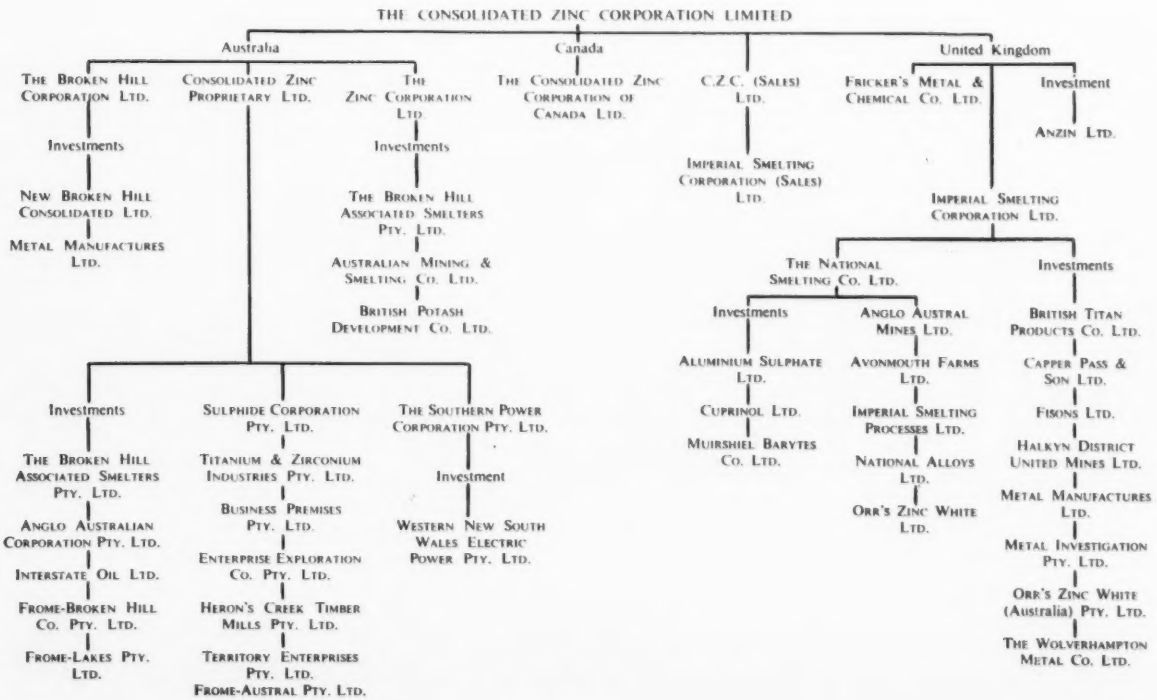
PRODUCTION

	The Zinc Corporation Ltd.		*New Broken Hill Consolidated Ltd.*	
	1954	1955	1954	1955
Ore treated (tons) ..	593,209	652,726	483,461	530,044
Lead concentrates produced (tons) ..	111,087	113,126	56,564	58,254
Containing :				
Recoverable lead (tons)	81,921	83,479	41,632	42,767
Silver (ounces) ..	1,834,257	1,832,893	808,406	848,350
Zinc concentrates produced (tons) ..	110,972	116,645	127,180	133,695
Grade per cent zinc	52.5	52.6	51.8	51.3

OTHER AUSTRALIAN INTERESTS OF THE CONSOLIDATED ZINC CORPORATION

The Consolidated Zinc Corporation owns 50 per cent of the issued capital of The Broken Hill Associated Smelters Pty. Ltd. which treats lead concentrates produced from the Broken Hill field at its Port Pirie smelter in South Australia. Early lead refining operations at Port Pirie followed conventional lines, but as a result of scientific research and an intensive development programme the present continuous lead refining process was brought into operation in 1932. More recent research has been directed towards the evolution of a completely continuous

ORGANIZATION CHART



Aerial view of Broken Hill

vacuum dezincing process to be employed in the refinery to recover metallic zinc from the lead smelting residues.

Titanium and Zirconium Industries Pty. Ltd., a wholly owned subsidiary of the Group, is engaged in the recovery of rutile, ilmenite and zircon from beach sands at Stradbroke Island, Queensland. During 1955 considerable construction work was carried out to equip this property for large scale production.

The Rum Jungle uranium mine is operated on behalf of the Australian Government by Territory Enterprises Pty. Limited, another subsidiary of the Group. This important mine was brought into production in 1954 and during the past year the first shipment of concentrates was made.

Another member of the Group, Sulphide Corporation Pty. Limited, produces sulphuric acid and phosphate fertilisers at its Cockle Creek Works in New South Wales. A new contact acid plant was commissioned during 1955.

Through its ownership of 51 per cent of the issued capital of Interstate Oil Pty. Ltd. the Group is participating in the search for oil in Australia in partnership with Vacuum Oil Company Limited and the D'Arcy Exploration Company Limited.

The search for new base metal deposits in Australia is conducted on behalf of the Group by a member company, Enterprise Exploration Pty. Limited, which also engages in drilling and exploratory work under contract with other organizations.

IMPERIAL SMELTING CORPORATION LIMITED

This company's principal activities are the production of zinc and sulphuric acid. At its smelting works at Avonmouth and Swansea, over 80,000 tons of zinc metal is produced per annum and the sulphuric acid plants at Swansea, Seaton Carew, Avonmouth and Newport provide over 250,000 tons of sulphuric acid per annum.

Production of virgin zinc metal by Imperial Smelting Corporation in 1955 was the highest in the Corporation's history. This was due mainly to successful operation of the new "Imperial Smelting Process" for smelting zinc or zinc in association with other metals. The development, operating on the blast furnace principle, is one of which the Corporation feels justly proud.

To meet the requirements of the many customers in the galvanizing and brass industries for supplies of zinc in "palletized" form, delivery of "Severn" zinc in pallets was introduced during the year and later this service was extended to both "Avonmouth" and "Swansea Vale" brands of zinc wherever required.

The completed modifications to the sulphuric acid plants at Avonmouth and Swansea resulted in a record tonnage of sulphuric acid being produced.

Mazak and Kayem are produced at Bloxwich and in addition, a large proportion of the United Kingdom's zinc dust requirements. During the year of 1955 there was a rising demand for zinc alloy die castings and this resulted in higher production and sales of Mazak zinc alloys. A large amount of additional capacity has been installed by the die casting industry to meet the requirements of the manufacturers of refrigerators, washing machines, electrical appliances and domestic equipment, etc.

At Widnes, lithopone, ground white barytes, zinc and cadmium sulphides and high strength zinc pigments are produced. The movement towards the greater use of high strength zinc pigments has necessitated intensified production which has been achieved, but it has not been gained at the expense of the standard lithopone pigment production.

In addition, the company owns barytes mines in England and Scotland. Barytes is used in the manufacture of lithopone and development of the Gasswater mine in Scotland has continued and the total production of this raw material has been maintained to meet the wider demands for zinc pigments.

Owning and operating a fluorspar mine in County Durham, Imperial Smelting Corporation has a mill at Nenthead in Cumberland where the fluorspar is treated and afterwards passed to the Corporation's Avonmouth Works where it is used in the manufacture of anhydrous hydrofluoric acid. The Corporation has pioneered the large scale production of this vital product in the United Kingdom and has done considerable market development work in promoting its use. In recent years, new outlets have been found for this chemical in its application for the production of fluorocarbons and a long-term contract with certain oil refining interests has been made. The United Kingdom Atomic Energy Authority uses anhydrous hydrofluoric acid from Imperial Smelting Corporation. This requirement for the production of atomic energy will take the productive capacity of the existing plant up to its full extent.

Research investigations in organic fluorine compounds are being continued and the applications of some interesting products has been studied, with results that have proved to be most gratifying. Products based on fluorine include boron trifluoride and the "Isceon" range of refrigerants and aerosol propellants.

Aerial view of the Avonmouth works

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Fué en 1905 cuando se hicieron los primeros ojales de extremo de cable Reliance y se instalaron en una mina de carbón del Pais de Gales. Hoy, en este pais y en muchos otros paises, hay millares de ojales de extremo de cable sujetando los cables que llevan a los hombres y a los productos de sus trabajo hacia arriba y hacia abajo en los pozos de mina del mundo entero. Durante medio siglo los accesorios para cables Reliance han probado ser sencillos, económicos y seguros.

LOS PRODUCTOS RELIANCE INCLUYEN

Ojales de extremo de cable de extracción y de guia, guarniciones de suspensión, casquillos, enchufes, mecanismos de tensar, accesorios de cable plano de equilibrar, acoplamientos aéreos, etc.

Reliance 'B' type winding rope Cappel made in Grade 'A' iron or 1.5% Manganese Steel

Ojal de extremo de cable de extracción Reliance tipo "B" hecho de hierro de grado "A" o de acero al 1.5% de manganeso.

Long Loop guide rope Cappel for suspending weights to end of guide rope.

Ojal de extremo de cable de bucle largo para suspender pesos en el extremo de los cables de guia.

Under-Frame type guide suspension gland.

Guarnición de suspensión de guía de tipo de bastidor inferior.

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Mount Isa Mines Limited

ALTHOUGH youngest of the larger Australian mining fields, Mount Isa has become the Commonwealth's major producer of blister copper and a most important source of silver-lead-zinc.

Australian copper production totalled 38,752 tons for the year ended June 30, 1955, of which Mount Isa Mines produced 21,585 tons. Plans are in hand to increase the annual blister output to 30,000 tons.

The company has taken advantage of favourable metal prices to carry out an extensive diamond drilling programme and to consolidate and develop its assets.

Mount Isa is situated in North-Western Queensland, 603 miles from Townsville, the nearest port. This isolation and distance brings special problems. While revenue has undoubtedly increased, the increase has been offset to some extent by necessary increased expenditure on goods, services and development.

It can be assumed that high transport and labour costs and fuel will claim an increasingly large share of revenue for the year ended June 30, 1956. Income for the year ended June 30, 1955, totalled £13,853,046. Of this £4,396,782 was paid to employees for wages, salaries, lead bonus, superannuation, etc., another £2,490,594 went to outside suppliers of production and maintenance materials and for external services. The Government Railways was paid £1,737,428.

The company's mine property, plant and machinery to date have cost more than £14,600,000. Because of the long distance, and the possibility of being isolated by flood, higher-than-average quantities of stores and materials must be kept on hand to ensure smooth production. More than £2,000,000 is tied up in such a way at Mount Isa.

The history of the company is one of development largely financed from earnings. The lead-zinc-silver ores of the Mount Isa series were discovered in 1923. In the rush which followed, 500 claims were pegged in an area three miles wide and eight miles long. Smaller owners eventually transferred their leases to stronger organizations, from which, in 1925, Mount Isa Mines Limited emerged as principal lease-holder. Active development began in 1927, when a controlling interest was purchased in the company by Russo-Asiatic Consolidated Limited. In 1930 the American Smelting and Refining Company purchased the control. The additional finance allowed completion of the development programme, and in 1931 mining, milling and smelting operations were started.

Mining of lead-zinc sulphide ores, and the production of lead bullion and zinc concentrates, continued until 1943, when the war-time shortage of copper warranted the development of a copper orebody located in massive dolomite to the west of the lead-zinc lodes.

The company produced 10,500 tons of copper in 1944, 12,250 tons in 1945 and 9,500 tons in 1946 when copper operations were suspended to modernize and expand the copper treatment plant. Since the resumption of copper production in February, 1953, the company has been unable to enjoy the full benefits of this additional activity. During the year ended June 30, 1954, only 13,151 tons of the total 20,407 tons produced were sold owing to the necessity of filling the pipeline to the company's consumers. With the carry-over from the preceding year, this meant that 12,213 tons of blister were in the pipeline. However, the company, during its last financial year was able to take some advantage of the higher price prevailing for copper although the carry-over is still considerable.

Mount Isa is now firmly established, not only as an important silver-lead-zinc mining proposition, but also as a substantial copper producer. The company paid its maiden dividend in 1947. Revenue at the time was derived from its three traditional sources of income, namely silver, lead and zinc—apart from a small tonnage of copper recovered from the dross. Revenue from the sale of copper is now playing an increasingly important part in the company's finances.

Year to June 30	*Ore Milled (tons)*	*Silver (ozs.)*	*Lead (tons)*	*Copper (in dross)*	*Zinc (tons)*	*Copper (blister)*
1955	1,244,192	3,370,920	39,730	893	17,701	21,585
1954	1,210,980	3,090,936	37,926	682	20,513	19,869
1953	847,900	3,195,374	38,536	576	21,413	5,477
1952	626,000	3,296,147	38,319	616	23,827	—

Copper ore reserves at the end of June, 1955, totalled 5,100,000 tons carrying average values of 4 per cent copper. The production statistics in the above table reflect the current scale of operations and indicate that Mount Isa Mines is becoming one of the great base metal mining enterprises in Australia.

After an extensive prospecting programme the company has decided to concentrate on the highly mineralised Mount Isa Cloncurry region. Of several areas which were seriously investigated, only the Northern prospect gives hopes of living up to original expectations. This major lead-silver-zinc deposit was discovered over four years ago about 13 miles north of the mine. Extensive diamond drilling showed that it offered attractive possibilities as a very low-grade open-cut mining proposition. Further probings since that time showed that values increased with depth, and underground mining may be possible below the limits of open-cutting. The Northern Leases discovery was the direct result of intensive geological work, followed by diamond drilling.

Exploration has also continued from the surface and underground in the vicinity of the Black Star orebody. Further extensions to the large low-grade silver-lead-zinc orebody were disclosed. While the limits of this deposit have not yet been determined, from the evidence available it is clear that to work this ore occurrence, large capital expenditure and mining at a greatly increased rate are essential. Under existing conditions the mining and treatment of this great reserve of low-grade ore would not be economic. Its mining together with the higher grade reserve, is imperative if this national asset is not to be lost.

Drilling is also continuing in the vicinity of the No. 500 copper orebody and there are strong indications of the existence of large new deposits.

Year to June 30	*Metal Sales** (£A000)	*Mining Costs* (£A000)	*Lead Bonus* (£A000)	*Taxation* (£A000)	*Net Profit* (£A000)	*Dividend* (£A000)
1955	13,782	7,066	1,422	941	3,307	1,439
1954	10,548	5,838	1,034	520	2,096	1,151
1953	8,678	4,414	1,224	300	1,668	863
1952	10,941	3,346	2,169	2,135	2,179	1,151

* Less transport, refining and realization expenses.

The outlook for 1955-56 is bright. The copper price has been at record levels, lead and zinc values have been higher than for some years past, and silver has reached a price not obtained since the spring of 1920.

Under the Commonwealth Income Tax Act, the company can claim 20 per cent tax exemption on copper profits. During the year a substantial portion of the profit was derived from the production of copper, and in calculating the tax provision, due consideration has been given to this fact. Exempt income from this source is also tax-free when distributed to stock holders. But as final agreement has not been reached with the taxation Commissioner, no transfer has yet been made to a special tax-free reserve for dividend purposes.

Production of all metals and concentrates for the year ending June 30, 1956, seems destined to exceed that of previous years. Blister copper production totalled 10,413 tons for the first six months of the current year. Silver-lead bullion production amounted to 17,080 tons and zinc concentrates to 15,669 tons.

During the year the company has taken up four uranium leases covering 650 acres in the Mount Isa area and a further mineral lease is being sought over another 640 acres on the outskirts of Mount Isa. This latter area was previously held by the company.

At the last annual general meeting the Chairman of Directors, Mr. G. R. Fisher, turned his attention to the present taxation laws in Australia, and pointed out that all metals other than silver-lead-zinc received a taxation exemption of 20 per cent. The investment of large capital sums in the mining of low-grade silver-lead-zinc at Mount Isa was not attractive under present conditions, he said. Accordingly, strong representations were being made to the Federal Government seeking taxation conditions for silver-lead-zinc mining at Mount Isa similar to those applying to all other non-ferrous metals.

At present much of Mount Isa's blister copper is exported overseas for refining on poll. If sufficient refining capacity were available there is no reason why the whole Australian production could not be treated in Australia.

To round off the picture, it is of interest to record that in 1951 Mount Isa acquired the total issued capital of Mining Trust Limited which, in turn, owns the Britannia Lead Company Limited. Mount Isa Mines Limited also owns all ordinary shares plus 50 per cent of the preference shares of Bowen Consolidated Coal Mines Limited.

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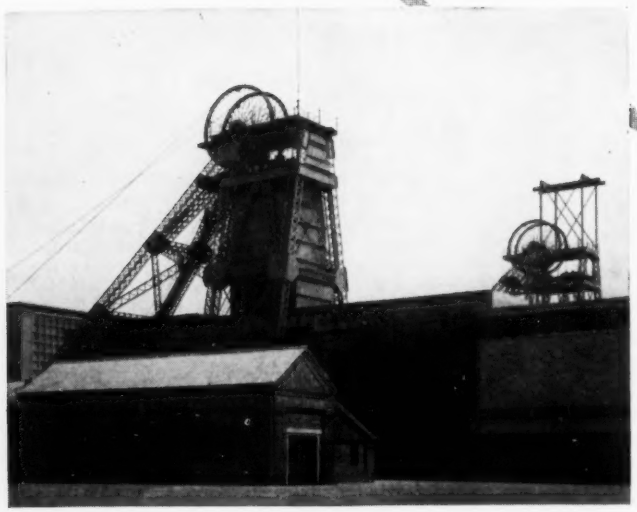

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North Kalgurli (1912) Ltd.

OPERATIONS SUBSTANTIALLY EXPANDED

AFTER more than 40 years' operations it is probably true to say that the ultimate potential capacity and profitability of North Kalgurli (1912) still lies in the future. But this does not imply that efforts to develop the mine in keeping with its potentialities have been lacking in the past. Indeed, during recent years much has been planned and achieved towards this end. In the technical field the most notable advance was undoubtedly the commissioning of the New Shaft in August 1952. While this opened up new possibilities for underground development in previously unexploited areas, it also enabled mill throughput to be increased from about 18,000 tons per four weekly period to its current level of about 27,000 tons.

In order to deal with the greatly expanded throughput — which is now expected to be maintained — arrangements have been put in hand to increase the capacity of the Croesus Proprietary Treatment Company's plant which is now entirely owned by North Kalgurli. As this and other outlays at the property will involve considerable expense, a conservative financial policy will be necessary until the new schemes mature. To assist in the provision of funds, a capital issue has been made since the end of the past financial period.

FINANCIAL YEAR-END CHANGED TO MARCH

In order to relieve the Kalgoorlie staff from pressure of work during the hottest and most trying months of the Australian summer, it was decided to change the financial year end from December to March. Production figures given in the table below, therefore, reflect a total of 64 weeks' operations up to March 22, 1955, against 52 weeks for previous years.

Year	*Treated* (*tons*)	*Grade* (*dwts.*)	*Yield* (*ozs.*)	*Devt.* (*ft.*)	*Ore Reserves** (*tons*)	(*dwts.*)
1955†	323,725	5.0	80,385	12,181	2,269,049	5.57
1953	253,967	5.3	67.017	10,805	2,265,193	5.51
1952	238,165	5.5	66,135	9,799	2,234,415	5.57

* Figures given relate to average of positive and probable tonnage and their estimated values per ton.

† 64 weeks period ended March 22, 1955 (1953 — 52 weeks).

IMPROVED EFFICIENCY BRINGS LOWER COSTS

A most encouraging aspect of the past financial period's operations was the lower level of costs. This reflected improved efficiences brought about by hoisting virtually all the mine's tonnage through the New Shaft. Moreover, in contrast with 1953, when three basic wage increases took place, wage rates remained unaltered. Besides this overall prices of industrial materials decreased by about 1 per cent from the average level of 1953. In consequence, operating costs dropped 2.77s. per ton milled.

Lower net profits before taxation at £123,879 during the 64 week period ended March 22, 1955, against £135,775 in respect of the previous 52 weeks, were primarily due to the virtual cessation of premium gold sales. Moreover, a somewhat lower grade of ore was milled.

Year	*Total Revenue*	*Taxation*	*Dividends*	*Net Profit*	*To Reserve*	*Carry Forward*
	£	£	£	£	£	£
1955†	911,104	54,546	46,750	20,177	24,571	42,292
1953	779,200	75,859	52,938	4,696	1,187	46,686
1952‡	796,586	60,526	52,250	Dr. 6,771*	96,853	43,177

* Before Cr.£96,064 from taxation provisions no longer required.

† 64 week period ended March, 22, 1955 (1953 — 52 weeks).

‡ Before consolidation.

Dividends on the issued capital of £220,000 in 2s. shares totalled 37½ per cent compared with 43¾ per cent for the preceding period.

At March 22, 1955, North Kalgurli's balance sheet showed total assets increased to £653,062 from £629,401 at December 31, 1953. This was due mainly to the acquisition of a half interest in Croesus Treatment from South Kalgurli Consolidated which raised the Company's investment in this asset from £41,161 to £162,154.

Although temporary arrangements have been made with the company's bankers for the provision of finance to meet commitments on hand, the necessity for more permanent capital has been recognised. Accordingly, shareholders have been offered 1,100,000 2s. shares at a price of 4s. per share in the proportion of 1 for every 2 held. This will provide £220,000 and increase the issued ordinary capital by £110,000 to a total of £330,000.

TREATMENT CAPACITY INCREASED

Work is at present in progress for expanding Croesus Treatment's capacity to 27,000 tons monthly at a cost of about £A220,000. By next August Croesus should therefore be able to handle all ore hoisted at North Kalgurli. The old Kalgurli Ore Treatment Company's plant will then be finally closed and dismantled. It is anticipated that on completion the Croesus extension will become immediately productive and enable savings of some £70,000 per annum to be made without delay.

Broadly speaking, the North Kalgurli property is divided into the Northern and Southern Sections. And although the Northern Section is in process of being brought back into production, by far the greatest part of the company's tonnage is at present drawn from the South.

The property's Southern part is divided into the North Kalgurli Section which includes the Genevieve and Brookmans Boulder Leases, and the Kalgurli section, which is comprised of Birthday South and Oroya North Block Leases. Two further contiguous leases — North Kalgurli and Birthday — are common to both sections. All these areas are served by the New Shaft which is one of the largest, most modern and most efficient on the Golden Mile.

One of the main objects of sinking the New Shaft — which is now to be deepened by a further 500 ft. — was to open up the interesting North Kalgurli east lodes below 8 level. Another essential part of a comprehensive development programme planned was a scheme of investigation to be carried out at the Oroya North Block Lease.

MINE CONTINUES TO OPEN UP WELL

So far information disclosed during the current year shows that the mine continues to open up well at depth. Development work is being pushed ahead at the high rate of some 5,000 ft. per 12 weeks compared with about 3,500 ft. previously, while large scale diamond drilling is being carried out.

In the North Kalgurli Section opening up of the eastern system of lodes has been pursued on the 10 and 11 Levels and results have indicated a continuation of the ore structures through these horizons with undiminished strength. Other interesting development results have included good average values from the Dower Lode up to 10.9 dwts. per ton. Work on the Tyrell Lode, however, has intersected an area of intense local faulting. Although ore disclosed at Tyrell has been of a high grade it has also been patchy, and more work will therefore be necessary before an assessment of its potential becomes possible. On the Main West Lode, large quantities of ore have been exposed having an average value around 6.5 dwts. over exceptional widths up to 9½ ft.

OROYA NORTH BLOCK DEVELOPMENT

Perhaps the most interesting development work at the property, however, has been that on the Oroya North Block. An east crosscut on 8 Level has been extended into this area and is planned to connect via a short rise with 7 Level of the Pomeroy shaft. This will later be used as a haulage way to deliver ore to the New Shaft. Diamond drilling has disclosed some exceptionally high values at Oroya. On 4 Level Hole No. 1, 124 intersected 36 in. of ore assaying 123 dwt. per ton, while on 5 Level, Hole No. 1, 170 bored west from a position 40 ft. south of Pomeroy Shaft in section B.B.15 south intersected 6 in. of ore assaying 119.0 dwts. per long ton.

PRODUCTION DURING YEAR 1955/56

Operations at North Kalgurli from March 23, 1955, until March 20, 1956, have resulted in about 360,500 tons being milled from which 76,787 fine ounces of gold were recovered. The interim dividend payment of 12½ per cent has been maintained.

Tronoh-Malayan Tin Group

THE Tronoh-Malayan Tin group continues to be interested in prospecting for new areas. A company, Tromal Prospecting Ltd., is engaged in examining the sea-bed off the coast of Siam, near Bhuket. Already leases have been granted over 7,500 acres for 25 years from 1954, and an operating company, Aokam Tin Ltd., has been formed with the Siamese Government large shareholders. A grab dredge will be used for the first time in large-scale tin winning, and a tanker is being converted for the purpose. It is expected that the grab will start operating in 1956.

TRONOH MINES LIMITED

Primarily, Tronoh Mines is a large scale tin producer operating in Malaya, but it also has considerable indirect interests in the Malayan tin mining industry. In the balance sheet as at December 31, 1954, quoted investments were carried at a book figure of £907,245, and the market value was £1,151,216. It also held unquoted investments with a book value of £44,175. Among these interests are big holdings in three of the group's important producers, Ayer Hitam Tin Dredging, Sungei Besi Mines and Sungei Way Dredging. It holds a stake in Harrietville (Tronoh), which has now closed down owing to high costs in the Australian gold industry, and has sold its dredge to Ayer Hitam for use in tin recovery. Tronoh operates a wholly owned subsidiary, Tin Lay, in Siam, and it possesses shares in the companies Tromal Prospecting and Aokam Tin.

In total the four dredges ran for a longer period in 1954 than in the previous year ; No. 8 dredge was shut down for four months for a major overhaul, but No. 5 dredge made up for this when it encountered very favourable conditions. Altogether 1954 was a satisfactory year since the grade of ground treated was better — 0.70 lb. per cubic yard instead of 0.58 — and the amount of ground treated was larger. This led to an increase of 31 per cent. in output — from 1,982 tons to 2,595 — and the average price of tin remained virtually unchanged over the year.

A substantial addition to the revenue from sales naturally followed. Costs, reflecting the electrification of the three dredges at Kampar, were reduced from 13.3d. per cubic yard to 11.2d. and this caused a diminution in total working costs of over £26,000. With all these favourable factors, it is not surprising that gross profits grew from £481,745 to £731,864.

Inevitably the tax authorities took the lion's share, this liability absorbing £405,613 against £251,649. After allowing for this claim, and taking credit for £2,099 surplus on realization of investments and £1,043 underwriting commission, net profits amounted to £329,393 as compared with £233,104.

Shareholders were paid £216,375 against £130,500, 4s. per share having been paid on the old capital and 9d. per share on the new capital after it had been enlarged by a scrip issue, whereby shareholders became entitled to seven new shares for every three held. The 1954 payments were equal to 39 per cent. on the new capital.

During the year 1955, conditions were still very satisfactory : output rose another 8 per cent. to 2,794¾ tons and the price of tin improved slightly. So far a total of 47½ per cent. dividends has been made.

The current year has opened in good style, production rising to 711¾ tons as compared with 642 tons, and the price of tin, though it dropped as the year progressed, was higher than a year earlier. One dividend has been paid so far ; it amounted to 7½ per cent., comparing with an initial of 5 per cent. for 1955.

SOUTHERN TRONOH TIN DREDGING LIMITED

Such large differences exist between the results obtained by Southern Tronoh Tin Dredging in 1954 compared with the previous year, that it is clear that conditions were vastly changed. In 1953 one of the dredges was out of commission for electrification for a while and the other met an area of especially tenacious clay. In 1954 both dredges worked and the one which had been converted for electricity expanded the amount of ground it treated from 130,000 cubic yards per month to 180,000 cubic yards.

Since the grade of ground rose from 0.28 lb. per cubic yard to 0.77 lb., the expansion in output was enormous — 1,167 tons as compared with 190 tons. The policy of converting No. 1 dredge has paid off, for mining costs were halved at 12¼d. per cubic yard. This reduction in costs, combined with a very small increase in the price received for each ton of tin-ore, ensured a huge change in the financial results : instead of incurring a loss of £122,051, the company made a profit of £307,632.

As always the Governments concerned share in this prosperity : the tin royalty took £92,432 (£15,473) and income tax £141,761 (£8,115). Out of the net profits of £166,174, shareholders received £33,000, that is to say, 1s. 6d. per share, the remaining £133,174 being retained in the business. One dredge will probably cease production in a year or two, and the other, owing to the increased rate of working mentioned above, will have a life of roughly two-and-a-half years, instead of the four years estimated earlier. In order to replace these areas, the company has been prospecting on its own account — it also has interests in the Siamese prospecting and operating companies mentioned above.

Two rubber estates have been examined and they promise well enough for applications to be made for leases to be granted, but it is not known whether they will be granted.

The dredges were unable to live up to the exceptionally high standards they set themselves in 1954, and consequently output in 1955 dropped to 850¼ tons against 1,167. Nevertheless, three dividends have been paid so far, amounting in all to 27½ per cent. Almost certainly the board wants to improve the already strong financial position of the company : at the end of 1954, current assets totalled £530,020, and current liabilities, £76,473.

Production in the first quarter of 1956 showed a further decline, the tonnage being 184¾ against 241½.

MALAYAN TIN DREDGING LIMITED

Three out of Malayan Tin Dredging's four dredges were in operation during the financial year to June 30, 1955, the remaining dredge having been on a care and maintenance basis for a number of years. This was an improvement over the previous year when one of the three dredges only worked intermittently. As a consequence a bigger yardage was treated, but the lower average grade of ground treated reduced the amount of tin-ore produced to a level below that of 1953-54 : 1,584 tons against 1,884 tons.

Gross profit was £300,853 against £396,343, and even after the tax authorities had suffered a cut, net profits were much lower at £105,605 (£162,073). Nevertheless, shareholders received virtually the same amount in dividends, the almost negligible increase in the net cost being caused by the reduction in the income tax rate.

During the year the company made a scrip issue whereby shareholders became entitled to two new shares for every share held. This issue makes a direct comparison of the amount of dividend paid per share a somewhat complicated matter, since one dividend was paid on the old capital and the remaining three on the new. The total distribution is equal to 1s. 4d. per share in the enlarged capital.

The provision of a further dredge for the Kampong Gajah area is in hand. At the end of June, 1955, current assets—taking book values—amounted to £1,073,433, and current liabilities to £291,161 but if the market value of investments is taken — they show an appreciation of almost £230,000 — net current assets are equal to roughly £1,000,000.

In the first nine months of 1955-56, output has leapt to 2,102¼ tons, or over 400 tons more than in the whole of 1954-55. Two interim dividends have been paid for this period so far, each of 6¼ per cent., the same as for the corresponding payments for 1954-55, after allowing for the scrip bonus made after the first 1954-55 interim had been announced.

SOUTHERN MALAYAN TIN DREDGING LIMITED

In recent years Southern Malayan Tin Dredging has been enjoying a fairly stable level of production from its six dredges. In the year to June 30, 1955, the amount of tin-ore recovered was 3,037 tons, almost identical with the 3,030 tons of the previous year. The financial result was rather better since the price of tin-ore was about £36 per ton higher than in the preceding year, and consequently receipts from sales rose to £1,302,496 against £1,176,203.

Mining costs were roughly £32,000 higher at £537,711. As other expenses were £48,648 against £43,174, and sundry revenue items yielded approximately the same aggregate, gross profits came to £772,498 as compared with £671,592. Chief beneficiary of this improvement was the tax gatherer, whose claim amounted to £454,551, or roughly £80,000 more than in the preceding year. As a result of that impost, the net profits were only £24,000 or so better — a discouraging amount to retain after tin-ore sales had grown by more than £126,000.

From the amount left to the company, shareholders received payments costing £266,228, leaving £51,937 of the year's profits

to be retained. A direct comparison of the amount paid on each share is hampered by the making of a scrip issue during 1954-55 whereby holders of three shares became entitled to seven new shares. The 1954-55 distributions were equal to 32½ per cent on the enlarged capital.

The financial position of the company continues to be very strong. Current assets at the end of last June amounted to £2,502,372 and current liabilities to £484,905. The net current assets compare with the new capital of £1,441,667.

During the first nine months of the current year, output has fallen slightly to 2,054¼ tons, against 2,175¼ tons but whether this results in diminished profits depends on the price of tin, which so far has been favourable, and of course, on costs.

AYER HITAM TIN DREDGING LIMITED

An expansion in the amount of ground treated by Ayer Hitam's single dredge during the year to June 30, 1955, was accompanied by a decline in the amount of tin-ore won per cubic yard. Nevertheless the amount of tin-ore won rose from 1,250 tons to 1,413 tons.

This encouraging start was helped along by two other factors. First the price of tin was better in 1954-55 than in the preceding year, so that the revenue derived from sales improved from £505,817 to £625,080. Second, the total cost of mining this larger quantity dropped and consequently the cost per cubic yard fell sharply. Likewise the cost of producing each ton of tin-ore was lower — £103 as compared with £129 — and the average Singapore tin price for the financial year was £702 against £640. The working profit per ton was therefore £599 as compared with £511. In the end, gross profit for the year amounted to £448,517 against £319,341.

Although the Government had already participated in the more prosperous conditions by taking £112,425 in royalty — £91,527 in 1954-55 — it took £227,259 in income tax, an increase of more than £46,000. After making allowance for this liability, net profits came to £228,154 against £138,718. The dividend was, however, kept unchanged at 5s. per share and £126,904 of the year's profits were retained in the business.

Since the end of the financial year, production dropped severely, output being only 524¾ tons against 1,187¾ tons, this was the result of the dredge working somewhat lower-grade ground, but it is hoped that soon the dredge will reach a higher grade area.

In recent years boring operations were carried out in order to ascertain the quality and extent of some of the tin grounds, and these have proved so favourable that the board decided to equip the property with a second big capacity deep digging dredge. To help finance its purchase from Harrietville (Tronoh), dismantling, transport and re-erection with certain modifications, the company made an issue of shares to shareholders at 22s. 6d. per share on the basis of two new shares for every three held.

This issue brought in about £550,000 and the remaining £350,000 estimated to be required will, it is hoped, be met from the company's own resources ; at the end of last June net current assets exceeded £800,000.

The impending capital expenditure and the reduction in output already mentioned has led to smaller payments for the current year to date. The first two interim dividends amount to only 10 per cent each, whereas the corresponding dividends for 1954-55 were each of 25 per cent ; they were followed later by a third interim and a final, again each of 25 per cent.

SUNGEI BESI MINES LIMITED

Two different types of mining operations are carried out by Sungei Besi Mines. The first method is opencast working of 400 acres under mining lease near Sungei Besi, Selangor, Malaya ; this produced 628 tons of tin oxide in the year to March 31, 1955. The second method is dredging an area, known as Pelepah, at Kota Tinggi, Johore ; output from this section in 1954-55 was 582 tons.

The total output of 1,210 tons, against 1,176 tons, gave the company a revenue of £528,344 as compared with £465,009, and working profits of £183,051 against £134,423. On this occasion income taxes absorbed over half the gross profits, leaving a net profit of £82,607 against £78,149.

Dividends remained unchanged at 40 per cent and £46,222 of the year's profits were ploughed back into the business.

In the year to March 31, 1956, the output of tin-ore has reached 1,189½ tons and already three interim dividends have been paid on account of that period. This is the same as in the corresponding period of the previous year.

SUNGEI WAY DREDGING LIMITED

Throughout the year to June 30, 1955, Sungei Way Tin Dredging was enjoying more or less full operation from its three dredges, — the first time for a number of years — and this boosted output to 1,566 tons against 1,226 tons. Combined with this favourable turn of events was the better conditions in the tin market, the average price received for tin-ore being roughly 15 per cent higher than in the previous year. The coincidence of these two factors raised the revenue from ore sales to the equivalent of £687,325 against £488,667, while mining costs rose by the comparatively small amount of just over £10,000 to £391,190. The tax charge soared to £42,999 from £6,770 and net profits finished at £151,701 (£97,079). Three dividends — two interims and a final — totalled 45 per cent.

At one time it had been planned to close down one of the dredges for electrification during 1954-55, but delays in obtaining certain equipment forced a postponement and work did not start until October 1955. This task was reckoned to take about six months, but the quarterly returns give little indication of this interruption — output during the first nine months of current year amounted to 1,060 tons against 1,105 tons in the comparable period of 1954-55. This followed an improvement in the grade of ground treated by No. 3 dredge, which produced 979 tons, or 62 per cent of the total output in 1954-55. Incidentally, No. 2 dredge accounted for only 228 tons in 1954-55.

When the No. 2 dredge has been converted to electricity all the dredges will be powered in this way, and by taking power from the Central Electricity Board, it is hoped to reduce costs. Two interim dividends have been paid so far for the current financial year, the first of 10 per cent and the second of 15 per cent — the same as the dividends for the corresponding periods of 1954-55.

SUMMARY OF OUTPUT, PROFIT AND TAXATION

Name of Company	*Period Ending*	*Ground Treated (000 cu. yd.)*	*Tin Ore Recovery (tons)*	*INCOME*			*EXPENDITURE*		*Profit before Tax*	*Govt. Tin Royalty (see Ore Sales)*	*Taxation*	*Dividends*
				Ore Sales and Stock (less Govt. Tin Royalty) £	*Tribute Sundry Mine Revenue* £	*Interest Dividends etc.* £	*Mining Costs* £	*Head Office and other expenses* £	£	£	£	£
Malayan Tin Dredging Ltd.	30/6/55	8,243	1,584	690,762	13,141	68,981	339,881	132,150	300,853	126,090	193,728	135,000
	30/6/54	8,068	1,884	739,344	23,732	78,982	286,392	159,323	396,343	133,633	228,073	132,000
Southern Malayan Tin Dredging Ltd.	30/6/55	15,741	3,037	1,302,496	13,766	45,195	540,311	48,648	772,498	235,127	455,024	266,228
	30/6/54	15,329	3,030x	1,176,203	13,864	41,480	509,081	43,174	671,592	212,550	377,448	193,300
Tronoh Mines Ltd.	31/12/54	8,330	2,595	1,120,120	42,835	73,868	442,222	62,737	731,864	204,078	435,674	216,375
	31/12/53	7,691	1,982	854,493	58,554	98,239	468,456	61,085	481,745	155,181	251,649	133,500
Southern Tronoh Tin Dredging Ltd.	31/12/54	3,413	1,167	500,979	2,830	12,429	178,292	30,314	307,632	92,432	141,761	33,000
	21/12/53	1,505	190	81,356	4,310	17,726	212,365	13,078	—122,051	15,473	8,115	Nil
Ayer Hitam Tin Dredging Ltd.....	30/6/55	2,176	1,413	625,080	2,796	23,507	145,422	57,444	448,517	112,425	227,259	137,250
	30/6/54	1,796	1,250	505,817	773	22,424	160,791	48,882	319,341	91,527	180,623	99,000
Sungei Besi Mines Ltd.	31/3/55	2,284	1,210	528,344	3,128	5,530	326,260	27,691	183,051	47,190	99,027	36,385
	31/3/54	2,408	1,176	465,009	2,224	9,410	315,930	26,290	134,423	86,019	55,428	35,976
Sungei Way Dredging Ltd.....	30/6/55	6,958	1,566	687,325	6,623	6,896	391,190	114,905	194,750	†	42,999	84,070
	30/6/54	.. 5,387	1,226	488,667	7,771	6,011	380,473*	18,128	103,849	†	6,770	28,023

x includes recovery from dumps and tribute. * Includes tribute payment of £34,822 in year to 30/6/54 and £58,815 in year to 30/6/55. † Not available.

Redruth Malayan Tin Group

BY far and away the most important event concerning Malaya in recent months has been the decision that the Federation should attain full self-government and independence by August 1957, even if the emergency is not over. The next few years are therefore going to be anxious ones for the tin companies.

The Malayan delegation which attended the constitutional conference in January, 1956, gave some outlines of the Federation's aims when independence had been achieved. It expressed its desire to stay within the Commonwealth and also to retain membership of the sterling area, the Federation Government being responsible for exercising restraint in dollar expenditure. The conference recommended that all financial matters in the Federation should at once be transferred to a Malayan Minister of Finance, but it was recognised that aid from the British Government would be necessary to finance part of the cost of the emergency, at least before independence and probably afterwards. The British Government is also prepared to consider helping the Federation in borrowing on the London market, and if necessary to assist in financing Malaya's contribution to the Tin Buffer Pool.

TEKKA TAIPING LTD.

The financial year to October 31, 1955, falls into two fairly distinct phases. During the first five months of that period, output was good and 235 tons were produced. But the ground immediately ahead of that area was thought to be of poorer quality and these fears were realised to such an extent that in the remaining seven months, only 144½ tons were produced ; this is rather less than one-half of the monthly average of the previous period. The combined results of these two phases brought total production up to 380 tons, and this in turn was very much better than the previous year, when output was only slightly more than one-half, that is to say 194 tons. Incidentally, the improvement over the year 1952-53 was due to skilful manoeuvring of the dredge — the company is only working one — and this is a problem which threatens to recur.

The increase on the physical side was not accompanied by a corresponding expansion in the financial side. First of all, the average price of tin-ore dropped from £443 to £409, and this had the effect of restricting the improvement in the amount received from the sale of ore to £184,245 against £131,653. The Government took nearly an additional £8,000 in royalty payments. After taking account of a somewhat heavier smelters' charge at £598, and taking advantage of mining expenditure lower at £83,445 against £85,100 — a very creditable performance in the circumstances — and of a higher sundry revenue, working profits for the year came out at £73,038. Working profits in the preceding year had amounted to £29,320. Once again the Government took its share — no less than £46,894 as compared with £16,471 — and after suffering from a smaller revenue and bigger head office expenses, net profits were only £28,197 against £12,849. In other words, the £32,600 expansion in receipts from ore-sales yielded only £15,300 extra net profits. Three interim dividends were paid for 1953-54, amounting to 12½ per cent in all.

The poorer conditions of the latter part of 1953-54 persisted into 1954-55, output having fallen to 221¼ tons or less than two-thirds of the previous year, though it was still better than the figure for 1952-53, and in the first five months of the current year output had declined to 37½ tons against 109¼ tons.

Early in 1956, resolutions were submitted to shareholders to consider the return in cash of 5s. per issued £1 share. The reason for these proposals was that the company had ample liquid resources, even after allowance had been made for the need to search for new areas to work at the end of the next few years. At the end of October, 1954, current assets amounted to £302,852 and current liabilities to only £32,410. This left net current assets at £270,442, and quite as important as the size of this item is its very high liquidity. The repayment of 5s. per share will, of course, alter all this, besides the changes wrought by the passing of time ; nevertheless, the company should still be liquid enough to meet the future. At the date of going to press the Court sanction had not been obtained ; when that has been given the nominal value of the shares will be 15s.

GOPENG CONSOLIDATED LIMITED

Gopeng Consolidated's assets fall into three main headings : first and by far the most important is its ownership of 1,860 acres of tin-bearing land at Gopeng, Perak, Malaya. Secondly, it possesses the Moynalpy Rubber Estate which extends over 563 acres and half-share in Sanglop Rubber Estate. Thirdly, it owns a number of investments ; at September 30, 1954, the quoted investments carried in the books at £163,966, had a market value of £175,932, the bulk of these investments being in British Government securities, though there is a fair leavening of commercial and industrial securities, with some interests in tin and rubber companies.

Some years ago the board decided to undertake the major engineering feat of diverting the chief water-supply to the property. This supply which is connected to two of the company's three paddocks — the third, named Geruntong, is the least important — naturally reduced the amount of tin which could be won while the diversion operation was in hand. But since then output has risen satisfactorily. This expansion coincided with the improvement in the price of tin during the year to September 30, 1955, thus leading almost certainly to much better financial results, which are reflected in the increase in the amounts paid for the year 1954-55 at the time of going to Press. Five interims have so far been paid totalling 50 per cent as compared with an aggregate of 25 per cent for the five interims paid for 1953-54.

According to the quarterly reports issued, production of tin ore in 1954-55 amounted to 759 tons, an increase of 35 per cent over the 563 tons produced in 1953-54. At the same time the price of tin metal on the London Metal Exchange averaged £723 for 1954-55, as compared with the £690 which the metal averaged during the preceding year.

Undoubtedly some items in the accounts for the financial year 1954-55 will be larger than in the preceding year and this will tend to reduce the benefit which might otherwise occur. Government royalties and smelter charges, for instance, took £45,717 in 1953-54, but these are likely to be larger, and taxation provisions which by taking £79,336 in 1953-54, absorbed 55 per cent of the year's gross profit, will help to reduce net profit even if the proportion of profits so taken is not increased. Nevertheless, it will be surprising if some of the year's profits are not ploughed back in accordance with tradition, and the financial strength of the company further improved. At the end of 1953-54, current assets, taking quoted securities at their book value, amounted to £365,588, against £121,534 current liabilities, a surplus of over £244,000.

The future is not clearly discernible ; the International Tin Agreement has been ratified by enough signatories to bring it into operation, but as the chairman told stockholders at the last annual meeting, he is not prepared to venture an opinion as to what its effect will be. Meanwhile, the expansion in output has continued into the current financial year, output during the first half of the year being 407 tons against 373¼ tons.

RAMBUTAN LIMITED

By far the most important of Rambutan's three paddocks now in operation is that designated " Z " ; it accounted in the year to June 30, 1955, for 193 tons out of a total output of 233 tons, most of the remaining tonnage having come from Paddock " W ". This was in the main the position at the end of the previous financial year, but as the changeover from Paddock " Y " took place half-way through 1953-54, the new Paddock was able to contribute for only a part of the year. The improvement in the physical returns of Rambutan in 1954-55 are therefore a reflection of a whole year's operation in the new main paddock. But they are more than that, for Paddock " Z " yielded a much higher grade than in the previous year : 0.80 lb. against 0.64 lb. At the end of last June, the plant in use at this paddock was as follows : one 2½ in. monitor, one 3 in. and one 2½ in. elevator, and an 8 in. horizontal pump at the upper level, and two 2 in. monitors feeding a 7 in. vertical pump at the lower level.

A slightly higher price for the larger quantity of tin-ore pushed up the revenue from £75,576 to £117,651 and the Government took a share in the form of increased royalties — £18,234 against £11,928. Mining expenditure was £4,000 or so greater at £45,387 ; nevertheless mining profits were roughly doubled at £56,521. Tax liability also rose in approximately the same proportion to £31,065 and net profits ran out at £24,022 as compared with the previous year's £10,993. Dividend payments were stepped up from 2s. 3d. per share to 7s. costing £19,750 and leaving £4,272 to be retained in the business.

During the first nine months of the current year, production of tin-ore has kept up to a satisfactory level, amounting to 165 tons as compared with 173¼ tons in the corresponding period of 1954-55. The general managers have stated that prospects for the current year are favourable and that the improved rate of output should be maintained. Up to the time of going to

press, the company has paid two interim dividends, the first of 10 per cent, and the second of 7½ per cent. In the preceding year, four distributions in all were made, the first two being each of 7½ per cent, and the third and fourth, each of 10 per cent. Although the price of tin has been satisfactory, the probable approach of the International Tin Agreement is probably causing the board to be a little cautious ; at the last annual meeting the chairman said that if the Agreement comes into force the company's output may be adversely affected.

TEKKA LIMITED

Work has been continued fairly steadily on the 956 acres of alluvial tin lands owned in the Kinta district of Perak, Malaya, by Tekka Limited. Production of tin ore amounted to 149 tons in the year to March 31, 1955, the same amount as in the previous year. The price of tin metal was about 11 per cent better during the latter period, ore sales realising £75,713 as compared with £68,351 in 1953-54. The Government shared in this prosperity, taking an extra £1,000 or so in royalty and more than an additional £2,200 in taxation. Mining expenditure, too, was larger : £44,019 against £35,087, but against that sundry revenue realised £5,391 as compared with £2,005. In the end, the net profit was somewhat lower at £10,510 against £11,700, and this latest profit figure covers with a small margin the cost of the dividends, amounting to 5 per cent. The year 1954-55 was the fourth successive year in which such a distribution was made.

The balance-sheet at March 31, 1955, continued to show impressive strength. Current assets, taking quoted investments at book value, totalled £175,346, while current liabilities amounted to only £15,778. These liabilities were so small that they were less than the excess of the market value of quoted investments over their book value. Moreover, a larger proportion of the current assets were in more or less liquid form, investments and cash accounting for about 93 per cent of total current assets. The company is well able to meet whatever demands the new tin agreement might impose.

In the year to March 31, 1956, output has been running at a slightly lower level — 138¼ tons against 149 tons — but the average price of tin was a shade higher, so that profits are unlikely to be greatly changed. The two dividends already paid for 1955-56 amount to 2½ per cent the same as in recent years.

KENT (F.M.S.) TIN DREDGING LIMITED

A glance at the balance sheet of Kent (F.M.S.) Tin Dredging at December 31, 1954, would suggest that the company had only a slight interest in mining since current assets at that date had a book value of £248,259 and fixed assets only £40,000. Reference to the profit and loss account would, however, quickly dispel any such illusion, since mining revenue accounted for £182,645 out of a total of £185,454. The company is very much interested in mining for its own 645 acres in the Kuala Lumpur area of Selangor, Malaya ; 35 acres on a mining lease direct from the Government and 610 acres on a sub-mining lease, which involves the payment of tribute.

Owing to a fall in the amount of ground treated from 1,601,000 cu. yds. to 1,582,000 cu. yds. and, more importantly, owing to a decline in the quality of the ground treated, the amount of tin-ore recovered dropped from 415 tons to 359 tons. As a consequence, ore sales brought in about £34,000 less than in the preceding year, and Government royalty took only £28,086 against £33,689. Mining expenditure contracted, and mining profits were down to £57,728 as compared with £83,347 for 1952-53. Only a small part of this diminution in working profits was reflected in a reduced tax liability which absorbed £33,916 against £34,375. This brought the net profit for the year down to £18,905, or less than one-half of the 1952-53 total of £46,274. Dividend payments for 1954 kept up well, a total of 40 per cent being paid, though 15 per cent came from a tax provision no longer required.

In the year to December 31, 1955, output fell further still reaching a total of only 260½ tons, and 1956 opened even less auspiciously, production in the first quarter amounting to 52¾ tons. This was the same as in the previous quarter, but it was well below the level of the first quarter of 1955, when 71½ tons were produced. To date two dividends have been paid for 1955, each of 10 per cent.

PENGKALEN LIMITED

Pengkalen Works its property in Pengkalen, Lahat, Malaya, with a single dredge ; its property consists of two parts, on the one hand it owns approximately 800 acres and it holds mining leases over another 226 acres.

In the year to September 30, 1954, the volume of ground treated dropped from 2,260,900 cu. yds. to 1,983,900 cu. yds. Incidentally this decline was accompanied by a cut of only 5 per cent in mining expenditure. Fortunately, the lower quantity treated came at a time when the grade was improving from an average of 0.32 lb. to 0.60 lb. per cu. yd. This large increase in the average grade expanded the total amount of tin-ore produced from 321 tons to 536 tons.

Revenue from tin-ore sales grew less vigorously than might have been expected from the figures just quoted, the average price of tin-ore during this period having been down to £411 against £472 a year earlier. The slight fall in the amount of mining expenditure mentioned above took up all of this fall. Since the production of 536 tons cost £94,380, the average cost, reckoned before tax and head office expenses, was £176, leaving an average profit of £235 ; in the previous year, the output of 321 tons cost £98,844, an average of £308, giving an average profit per ton of £164. As the increased profit applied to a larger tonnage the effect on working profit was most marked, rising from £64,254 to £133,193, and net profits from £39,885 to £52,445.

Higher profits enabled the board to make more generous dividend payments, raising the rate to 55 per cent on the ordinary shares, the best for a number of years. By the time that this distribution had been made, and £1,263 had been written off capital expenditure, only £3,253 of the year's profits remained to be ploughed back. But the company's finances were improved as the result of the writing back of £25,070 taxation provisions no longer required. Admittedly, this non-recurring item was reduced by the appearance of another non-recurring item on the other side of the account — £15,054 for expenditure on bridge and weir — but the net result was that there was a windfall of roughly £10,000.

During the financial year to September 30, 1955, the output of tin-ore contracted from 536 tons to 421 tons, but some of this set-back has probably been cushioned by the receipt of a more favourable price. Already three dividends have been declared for that year, amounting in all to 35 per cent, the same amount as the corresponding payments for the previous year, but it remains to be seen whether the company pays a final dividend, which was 20 per cent for 1953-54. Production during the first half of the current year has shown an encouraging upturn, output being 308½ tons against 235½ tons, and this has been marked by the declaration of a single interim of 10 per cent.

SUMMARY OF OUTPUT, MINING PROFIT AND TAXATION

Name of Company	*Period*	*Ground Treated (000)*	*Tin Ore Recovery*	*Ore Sales*	*LESS*				*PLUS*	*Mining Profit*	*PLUS*	*LESS*	*Profit Before Tax*	*Tax*	*Dividend*
					Govt. Royalty	*Smelters' Charges*	*Tribute on Ore sold*	*Mining Expenditure*	*Sundry Revenue from Tribute, etc.*		*Sundry Revenue*	*Head Office and other Expenses*			
		cu. yd.)	*(tons)*	£	£	£	£	£	£	£	£	£	£	£	£
Gopeng Consol	30/9/54	2,181	563	281,927	43,771	1,946	—	114,477	24,251	145,984	13,641	15,192	144,433	79,336	54,418
	30/9/53	1,767	585	339,268	52,772	2,200	—	125,439	31,943	190,800	16,416	16,097	191,119	83,708	69,755
Kent (F.M.S.)	31/12/54	1,582	359	182,357	28,086	1,309	4,550	90,972	288	57,728	2,809	7,716	52,821	33,916	23,494
	31/12/53	1,601	415	216,566	33,689	1,559	4,442	93,877	348	83,347	4,646	7,344	80,649	34,375	28,875
Pengkalen	30/9/54	1,984	536	268,713	41,219	1,851	5,350	94,380	7,280	133,193	8,692	10,837	131,048	78,603	52,250
	30/9/53	2,261	321	183,264	28,296	1,185	2,437	98,844	11,752	64,254	13,069	7,201	70,122	30,237	29,875
Rambutan	30/6/55	841	233	117,651	18,234	718	426	45,387	3,635	56,521	4,415	5,849	55,087	31,065	19,750
	30/6/54	470	156	75,576	11,928	539	233	41,320	5,473	27,029	2,931	4,141	25,819	14,826	6,188
Tekka	31/3/55	377	149	75,713	11,600	504	268	44,019	5,391	24,713	7,172	2,988	28,897	18,387	10,197
	31/3/54	506	149	68,351	10,625	541	358	35,087	2,005	23,745	6,913	2,816	27,842	16,142	9,861
Tekka-Taiping	31/10/54	2,390	380	184,245	28,513	598	—	83,445	1,349	73,038	6,236	4,184	75,091	46,894	27,498
	31/10/53	2,027	194	131,653	20,854	394	—	85,100	159	25,463	7,294	3,438	29,230	16,471	5,500

LONDON TIN CORPORATION

LIMITED

CAPITAL

Authorised: £4,200,000. *Issued:* £3,618,236, in shares of 4s. each, fully paid.

REGISTERED OFFICE - 55-61, MOORGATE, LONDON, E.C.2

PROVIDES, THROUGH ITS SUBSIDIARIES, TECHNICAL MANAGEMENT, FINANCIAL AND SECRETARIAL SERVICES FOR TIN-PRODUCING AND DEVELOPMENT COMPANIES IN MALAYA, THAILAND, BURMA AND NIGERIA

MANAGEMENT ORGANISATION:

(Wholly-owned Subsidiary Companies):—

The Anglo-Oriental & General Investment Trust, Ltd. London

Anglo-Oriental (Malaya) Ltd. Kuala Lumpur, Fed. of Malaya

A. O. Nigeria Ltd. - - - - Jos, Northern Nigeria

A. O. (Australia) Pty. Ltd. - - - - Sydney, N.S.W

Petaling Tin Limited

AN exceptionally strong financial and technical background coupled with its established position as a large and well founded producer, places Petaling Tin in the forefront of Malayan tin companies. Moreover being incorporated in Malaya, the company does not incur the excessive burden of British taxation.

During the past financial year Nos. 3 and 6 dredges were in continuous operation, while No. 5 worked for five months under difficult conditions and with somewhat disappointing returns in the Seaport Area. No. 4 dredge is now being rehabilitated and it is anticipated that operations will commence in the middle of 1956.

Year to Oct. 31	*Treated cu. yd.* (000)	*Per Cu. Yd. Yield* (*lb.*)	*Cost* (*d.*)	*Output in tons* (*conc.*)	*Per Ton Ore Cost* £	*Price** £
1955	9,502.8	0.49	8.55†	2,088	162	430‡
1954	6,836.9	0.51	8.99	1,645	175	422
1953	7,734.1	0.53	10.98	1,847	192	465

* Less tribute.
† Actual cost £162 3s. 10d. per ton.
‡ Actual price £429 18s. 11d. per ton.

LARGE RESERVES OF GROUND

Of Petaling's four dredges, No. 6 has the greatest capacity and digging depth. Yet, because the major portion of the Puchong Area, in which it is operating, has already been worked by the shallower digging No. 5 dredge, returns are lower than those to be expected from completely virgin ground. In addition to the remaining life for this dredge in the Puchong Area, estimated in 1953 to be not less than two years, a reserve area at Castlefield Estate, situated nearby, has been acquired. This area is estimated to contain 50,000,000 cubic yards averaging 0.45 lbs. per cubic yard, giving a further life of approximately ten years.

Three years ago the Seaport Estate Area, in which the No. 5 dredge is now operating, together with 37 acres acquired from the adjoining Sungei Way Estate, were estimated to contain approximately 29,000,000 cubic yards, averaging 0.43 lbs. per cubic yard, giving a life of approximately eight years for this dredge.

When the rehabilitation of No. 4 dredge has been completed, it will join No. 3 dredge in deeper digging operations in the previously worked Main Sub-Lease Area.

Year to Oct. 31	*Mining Revenue** £	*Mining Costs†* £	*Taxation* £	*Net Profit* £	*Dividend* £	*Carry Forward* £
1955	909,762	338,622	135,613	342,109	305,433	122,878
1954	630,722	256,041	59,552	186,545	152,717	155,369
1953	866,025	353,850	124,367	281,572	251,534	115,961

* Proceeds from tin-ore, gold, ilmenite, and tribute collected.
† Including provision for plant renewals.

The past year's greatly increased profits have enabled dividends on Petaling's ordinary capital of £513,333 in 4,400,000 shares of $1 to be raised to 85 per cent from 42½ per cent.

In recent years considerable capital expenditure for dredge modernisation and conversion has had to be faced. Despite this, the company's consolidated balance sheet at October 31, 1955, revealed a position of exceptional financial strength. Total assets amounted to £1,979,027 against £1,793,704 previously, while current assets exceeded current liabilities and provisions by £798,172.

CURRENT OUTPUT DECLINES

Due primarily to the large volume of previously dredged ground being treated by No. 6 dredge during the current financial year, the total output is expected to be lower than during 1954-5. Indeed, results for the first five months showed that only 593.49 tons had been produced, compared with 941.22 tons during the corresponding period of the preceding year.

So far this year Petaling has declared two quarterly interim dividends of 7½ per cent. This compares with two payments of 12½ and 17½ per cent respectively in 1954-55.

E.V.S.
GEOPHONE

Seismic Instruments Ltd. present the E.V.S. Geophone! Tough and versatile, one unit can be used for either land, marsh or semi-buoyant operation merely by an exchange of top and bottom components. A range of frequencies, coil resistances and damping characteristics are available. Sensitive and dependable, you'll find the E.V.S. Geophone working wherever the most accurate results are wanted for a minimum of expenditure. *Please write for details of this geophone and of the range of seismic equipment being offered by Seismic Instruments Ltd.*

SPECIFICATION
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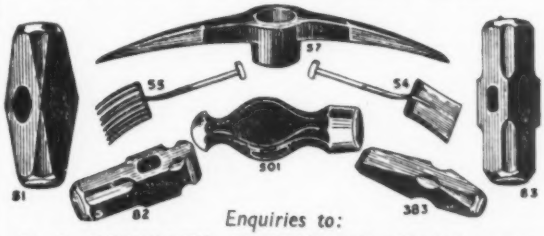

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Kinta Kellas Tin Dredging Company Ltd.

FACED with rising costs of labour and materials and a dredge whose capacity and operative efficiency could not easily be increased in order to offset falls in the grade of ground treated, Kinta Kellas Tin Dredging has had to struggle with many difficulties during the post-war years.

Yet, it is a tribute to the company that, despite its limited financial resources, and the serious effect upon yearly production that any stoppage of its one and only dredge obviously entails, a substantial modernisation programme has been successfully put into effect.

MODERNISATION OF DREDGE

While raising output capacity, this has involved a complete changeover from steam to electric power together with a partial conversion from tables to jigs. The capital expenditure required has, of course, been extremely large and absorbed most of the company's liquid resources. Yet shareholders — apart from having to accept a temporary cessation of dividends — have not been asked to provide any new money for the work. Accordingly, although the company has now become a very much more flexible producer than it was before, its issued ordinary capital has remained unchanged at £105,000 in stock units of 5s.

Year to March 31	*Total† Revenue*	*Mining* Costs*	*Taxation*	*Net Profit*	*Dividend*	*Carry Forward*
	£	£	£	£	£	£
1955	96,395	94,372	Nil	1,120	Nil	23,391
1954	121,566	115,990	634	2,812	Nil	19,876
1953	116,224	113,505	Nil	609	Nil	11,162

* Including royalty payments and depreciation.

† Tin proceeds amounted to £86 754; 1954—£115,095. 1953—£104,325.

Kinta Kellas Tin's total capital and reserves at March 31, 1955, expanded to £133,391 from £129,876 at the end of the preceding year. Reflecting large capital expenditure incurred, fixed assets were more than doubled at £100,158 against £48,019 while a similar change took place in net current assets which dropped to £59,453 from £117,528. Current liabilities and provisions totalled £26,220 compared with £35,671.

During the financial year ended March 31, 1955, Kinta Kellas suffered a fall in production. While this was primarily due to a six weeks' stoppage for dredge conversion, another substantial factor was the exceptionally low grade of ground treated. Indeed, as further unsatisfactory recoveries have persisted since the end of the past financial year, the particular section of the tin field concerned has since been abandoned and the dredge's course modified.

The results obtained for the years 1953-55 are detailed in the following table:

Year to March 31	*Dredging Time (hrs.)*	*Ground Cu. yds. (000)*	*Dredged Yield (lbs./cu. yd.)*	*Output tin ore tons*	*Per ton tin ore Cost £*	*Price £*
1955	5,920	1,475.0	.30	200	431	407
1954	7,028	1,486.6	.45	298	349	363
1953	5,384	1,079.6	.39	184	577	532

As the dredge stopped production on November 8 until December 27 — work was not resumed until January 1955 — only three months of the past financial year reflect operations subsequent to conversion being carried out. This being the case it is most encouraging that a reduction in costs to 14.06d. from 16.79d. per cubic yard should have taken place over the year as a whole. Moreover, as this improvement was not the result of increased productivity, it indicates a substantial increase in efficiency.

RISING TREND OF OUTPUT

That modernisation work carried out on the dredge is proving successful is apparent from the rise in output to 227¾ tons of tin concentrates which took place during the year ended March 31, 1956. Moreover, as average monthly output during the latter six months of this financial period was nearly doubled at 24 tons from the 13½ ton level achieved during the first half of the year, there is every hope that 1956-57 will show further gains. So far production during April — the first month of the current financial year — at 24.7 tons compared with 15 tons produced in April, 1955.

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CAPITAL
AUTHORISED: £2,250,000
ISSUED: £2,105,086 IN SHARES OF 10/- EACH FULLY PAID

Tanjong Tin Dredging Ltd.

TANJONG Tin Dredging Ltd. owns leases and subleases covering 643 acres in the Mukim of Tanjong Tualang in the Kinta District of Perak, Malaya. Until recently, the Company also owned 416 acres in lower Perak which it acquired in 1947 when it purchased the undertaking and assets of Sungei Luas Tin Dredging Ltd. The latter's 15 cu. ft. bucket dredge was then transferred to the main area where it was reconditioned and re-erected as No. 2 dredge and commenced operations at the end of November, 1950. The Company has, therefore, two dredges and both were in operation throughout the year.

Year to Dec. 31	*Ground Dredged (cu.yds.)*	*Per cubic yard Yield (lbs.) Tin Ore*	*Cost (pence)*	*Output Tons Tin Ore*	*Price rec'd per ton Tin Ore* £
1954	4,637,100	.37	8.8	776	421
1953	4,552,000	.39	9.0	780	428
1952	4,205,960	.52	10.5	981	590

Conditions throughout 1954 were generally good and running time was again satisfactory. No. 1 dredge, treating ground to a depth of 60 ft. continued on its southerly course along the Company's western boundary, where the ground treated was of lower grade than that worked during the previous year.

Uneven bedrock and clay restricted yardage to some extent and this, together with the lower grade of the ground, resulted in a reduction in output from this source. No. 2 dredge which can dig to a depth of 95 ft., continued to operate in a northerly direction mostly in ground previously treated by No. 1 dredge, but virgin ground was reached in October of that year. An increase in the yardage treated by this dredge and a slight improvement in the grade of the ground made up for the reduction in output from No. 1 dredge and resulted in the output from the mine as a whole amounting to only 3 tons less than in the year before.

During the year 1954, sale of ore — less export duty, smelters' charges and tribute etc.— provided £326,492 against £322,923 the previous year. Sundry revenue brought in £2,069 against £4,643 and income from dividends fell from £8,375 to £6,197.

Dividends from the company's issued ordinary capital of £185,834 amounted to 55 per cent. against 47½ per cent. for 1953.

Year to Dec. 31	*Total Revenue* £	*Taxation* £	*Net Profit** £	*Dividends* £	*To Reserve* £	*Carry Forward* £
1954	334,792	88,000	31,257	57,144	1,000	23,402
1953	336,008	90,200	43,725	47,852	NIL	46,707
1952	591,196	236,650	139,180	78,050	25,000	54,821

* After writings off.
Note.—Mining costs 1954 were £163,506. 1953—£169,681; 1952—£184,515.

The General Managers stated in their report that No. 1 Dredge was expected to reach the end of the sublease area during the first half of 1955 and would thereafter work partly in tailings and partly in virgin ground ; No. 2 dredge would continue to work in virgin ground and good returns were to be expected from these operations.

With No. 1 dredge working better ground in the final six months of 1955, there was a sharp improvement in output to 1,118 tons for the year. Already two interim dividends of 12½ per cent., one of 20 per cent. and another of 30 per cent. have been paid making a total of 75 per cent. on account of 1955. The first interim of 30 per cent. on account of 1956 makes a good start for the current year.

SUNGEI LUAS LEASES SOLD

The company has recently sold its Sungei Luas leases in the Tanjong Tualang District to Lower Perak Tin Dredging Ltd. which operates a dredge on the area adjoining. The payment received was £300,000 and the profit therefrom was transferred to a Capital Profit account. The Directors recommended the distribution of part of this capital profit by the payment of a special capital dividend of 100 per cent. on the shares of the company i.e. a payment of 5s. per share in cash. This was approved by shareholders at an Extraordinary General Meeting held on April 5, 1956.

The Kinta Tin Mines Ltd.

THE Kinta Tin Mines Ltd. owns a mining area of over 1,000 acres near Gopeng in the Kinta District of Perak, Malaya, which is worked by hydraulicing methods. In addition, the Company and Gopeng Consolidated Ltd. each have half interest in the Sanglop Rubber Estate of which some 800 acres are planted with rubber. The Company also has a large holding in Tanjong Tin Dredging Ltd. which is reviewed above.

The results obtained for the years 1952-54 are detailed in the following table :

Year to Dec. 31	*Ground Dredged (cu.yds.)*	*Per Cubic Yard Yield (lbs.) Tin Ore*	*Cost pence*	*Output tons Tin ore*	*Price rec'd per ton Tin Ore* £
1954	1,170,800	.67	16.0	352	416
1953	1,140,100	.67	15.7	339	407
1952	1,105,700	.61	14.8	304	572

There are two sections — the Lallang Section and the Damak Section — each, during 1954, with a large main mining paddock and some subsidiary operations.

Production from the Lallang Section during 1954 totalled 251.65 tons of tin ore representing a yield of .76 lbs. per cu. yd. from the 741,200 cu. yds. treated. This compared with the 1953 figure of 285.03 tons of tin ore from 842,300 cu. yds. averaging .76 lbs. per cu. yd. At the Damak Section, where sinking operations were in progress, the smaller total of 429,600 cu. yds. was treated from which 100.28 tons of tin ore were recovered representing a grade of .52 lbs. per cu. yd. This compared with 297,800 cu. yds, 54.13 tons of tin ore, and a grade of .41 lbs. per cu. yd. in 1953.

In December 1954 the economic limit of the mining paddock at the Lallang Section was reached and the plant transferred further south to the Damak Section where, as sinking progressed, the mining paddock was extended.

Dividends on the company's issued ordinary capital of £120,000 in 5s. shares for the year 1954 totalled 42½ per cent. This represented an increase of 10 per cent over that of the previous year.

Year to Dec. 31	*Total Revenue* £	*Taxation* £	*Net Profit** £	*Dividends* £	*To Reserve* £	*Carry Forward* £
1954	163,066	40,275	32,255	28,350	1,000	21,782
1953	160,910	43,145	15,642	21,150	Nil	18,877
1952	211,955	70,901	31,142	25,200	Nil	24,726

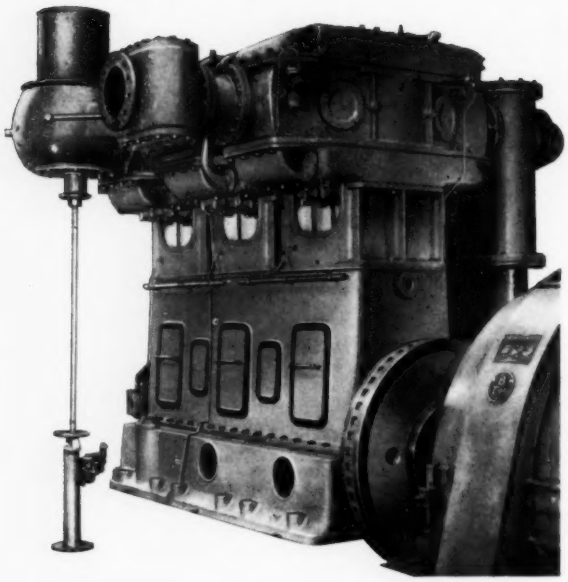
* After writings off.
Note.—Mining costs 1954 £79,624; 1953 £76,190; 1952 £68,952.

Interim dividend payments for 1955 have totalled 55 per cent or 12½ per cent more than the total distribution for 1954 and the first interim dividend at 10 per cent shows an increase of 2½ per cent on the corresponding payment for the preceding year.

The Kinta Tin Mines is strong financially and is fortunate enough to possess mining areas with a higher than average tin content. In addition, being a hydraulicing property, it has the useful attribute of flexibility. For these reasons alone the company is well-placed to face whatever restrictions the International Tin Agreement may bring.

RETURN OF CAPITAL

As there appeared to be no prospect of employing some of the accumulated surplus funds in the business, Kinta Tin recently decided to make a return of capital to its shareholders. Accordingly, a repayment of 2s. per 5s. share was proposed by the Directors and approved. After this return had been effected, the company's issued ordinary capital was immediately restored to its previous figure of £120,000 in 5s. shares by capitalizing £48,000 from general reserve. It will be recalled that it was initially planned to repay a total of 4s. per 5s. share but approval could not be obtained from the Capital Issues Committee. In April of this year a special Capital Dividend of 5s. per 5s. share was received by the Company on its holding in Tanjong Tin Dredging Ltd. and from the sum received a cash distribution of 7½d. per share was paid to Kinta Tin shareholders.



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Siamese Tin Syndicate Limited

IN recent years, Siamese Tin Syndicate—the large medium grade Eastern tin producer—has made considerable progress towards strengthening its mining position in both Siam and Malaya. Besides establishing reasonable reserves of dredging ground—particularly in the former country where its interests predominantly lie—it is expending part of its ample finances on modernisation and acquisition of dredges with a view to expanding production. In 1952, its previously associated company, Bangrin Tin Dredging, was taken over, while since the end of 1954 the shares of three other concerns, Renong Consolidated Tin Dredging, Katu Tin Dredging and Burma-Malay Tin, have been purchased.

Another interesting, although potentially small undertaking when compared with the company's large Eastern assets, is the scheme to rehabilitate and bring to continuous production the Lowland Lead Mines—an old lead-zinc property situated in Scotland. While the investment in this speculative but promising venture has provided a useful outlet for Siamese Tin's surplus funds, it also showed that the company's financial policy was not exclusively confined to tin mining in Siam and Malaya. This trend towards a more widespread distribution of risk has been regarded as most encouraging. Siamese Tin's group balance sheet at December 31, 1954 showed total assets at £2,223,376.

Although Singapore average market prices over the year approximated to those of 1953, the average price realised for tin ore by the group at about £499 compared with £538 during the previous year. This was, however, mainly due to Siamese Tin's favourable forward contracts expiring at the end of 1953. On the other hand, a reduction in Siamese export duty had the welcome effect of reducing costs sharply.

Year to	*Worked*		*Tin Ore Output*		*Per Ton Metal**	
Dec. 31	*Cu. Yds.* (000)	*Per Hour*	*Tons*	*lb. per cu. yd.*	*Cost* £	*Price* £
1954	10,330.4	195	1,971	.43	519	674
1953	11,014.1	195	2,613	.53	526	727

* Average price received less selling charges.

TEN OPERATIVE DREDGES

The Siamese Tin Group now has a fleet of ten operative dredges. Nine of these are situated in the Kra Isthmus area of southern Siam not far from the border of Burma, and the other works an area near Khota Bahru in Central Malaya. A further dredge lies dismantled on a care and maintenance basis partly at Khota Bahru and partly at Chemor, not far away. This dredge is a small one, and under present day conditions it may be difficult to acquire any area which it could work economically.

Because the Bangrin No. 1 dredge was docked for some four months during the financial year ended December 31, 1954, output from this area—normally by far the group's most productive section—fell to 449 tons of tin ore from 753 tons during the preceding twelve months. Ground worked by the two dredges amounted to 2,288,500 cubic yards as against 2,633,500 cubic yards previously. With a recovery at .44 lbs. per cubic yard compared with .64 lbs. only 449 tons of ore were produced against 753 tons. The lower productive capacity caused net costs per ton of metal to rise to £512 from £479. Reserves at Bangrin are good and it has been estimated that a future life of about ten years remains.

At Ngow the two dredges worked very much lower grade ground which yielded .45 lbs. per cubic yard against .58 lbs. previously. Moreover, the area worked at 1,870,000 cubic yards fell from the previous year's total of 1,983,500 cubic yards. Ore recovered accordingly decreased to 375 tons from 517 tons. A fall in costs to £547 per ton metal from £552, however, was brought about by the decrease in Siamese export duty. Disappointing results at Ngow have recently prompted a re-boring programme of the whole remaining area. This has resulted in total reserves being lowered to 4,761,000 cubic yards although values are slightly higher. A further life of about two to three years thus remains for the two dredges. In the short term, however, production should benefit from new courses which are being plotted.

Operating in the Takuapa Valley to the south-east of Bangrin and Ngow, the Koe Kein dredge worked ground at a grade of .44 lbs. per cubic yard as compared with .43 lbs. during the previous year. But as the total amount of ground treated rose to 1,509,000 from 1,467,000 the net result was an increased recovery of tin ore at 293 tons from 282 tons. Costs declined sharply to £351 from £496. Reserves in this area total over 12,000,000 cubic yards which should give the dredge a future life of about eight years. Koe Kein is one of Siamese Tin's most profitable units.

At Peek, also in the Takuapa Valley, values obtained were .44 lbs. per cubic yard as compared with .59 previously. The amount of ground worked declined to 1,548,000 from 1,661,000 with the result that output of tin ore dropped to 306 tons from 436 tons. Reflecting the lower export duty, costs fell to £326 per ton metal from £345. Due to new ground being reached during 1955, however, results should have shown an improvement over those of the previous twelve months. Reserves at Peek are small and amount to only 1½ years at present.

A total of 213 tons of tin ore compared with 271 tons was produced by the Huey Moot dredge during 1954 from the treatment of 1,541,000 cubic yards against 1,700,000 cubic yards. Huey Moot is a relatively low grade property, but reserves are large and values in the remaining part of the property are thought to be higher than in that already worked. Modernisation of the dredge is therefore being considered and it is hoped that this will bring about a considerable decrease in the present costs.

At Khota Bahru in Malaya 1,573,900 cubic yards of ground were worked by the dredge against 1,569,100 previously. Grade obtained was .48 lbs. per cubic yard compared with .50 lbs. and tin ore tonnage at 335 tons compared with 354 tons. Costs declined slightly to £550 per ton metal from £554.

Year to Dec. 31	*Total Revenue* £	*Taxation* £	*Net Profit* £	*Dividends* £	*To Reserve* £	*Carry Forward* £
1954	289,502	127,894	137,837	92,888	Nil	62,936
1953	362,113	209,141	134,822	88,242	Nil	64,539

Dividends on the Syndicate's issued ordinary capital of £546,400 in 2,185,600 stock units of 5s. totalled 30 per cent. During 1953 12½ per cent was paid on a capital of £300,000 and 22½ per cent on £546,400. In addition a 50 per cent, tax free, cash distribution was made.

LARGE RESERVES AVAILABLE

Largely with a view to equipping the company's new property at Bangnon in Siam, some ten miles from Ngow, estimated to contain 24,500,000 cubic yards averaging .57 lbs. of tin ore per cubic yard, Renong Consolidated Tin Dredging, Katu Tin Dredging and Burma-Malay Tin have been acquired since December 31, 1955. Renong's leases are close to those of Bangnon and its dredge should be available for that property in about three years' time. Katu's leases should provide profitable working for its dredge for some six years. Burma-Malay's assets consisted of cash and investments and were included in the negotiations as a matter of convenience only. Although Siamese Tin is constantly on the outlook for new dredging areas, its present position is one of considerable strength. At December 31, 1954, total reserves—excluding Bangnon—were estimated at 126,800,000 cubic yards containing 29,700 tons of tin ore.

GOOD RESULTS IN 1955

In the early months of 1955 it was decided that the known reserves of galena and blende (contained in virgin ore and "fill" underground and in rock and sand dumps spread over a wide area on the surface) should be developed to the point of production while at the same time a search for new sources of ore underground would be undertaken.

The mill for the treatment of the known reserves should be ready to start production at the rate of about 200 tons per day by the autumn of this year and with the price of lead well above the breakeven point of about £80 per ton set in its original operation plan, it would appear that the first phase of the venture is in sight of success. Meanwhile the search for new areas is proceeding and results to date are encouraging.

Monthly returns during the year ended December 31, 1955, have disclosed a substantial rise in production to about 2,600 tons of tin ore from 1,998 tons during the preceding period. Two interims of 17½ and 7½ per cent respectively have so far been paid compared with two of 5 per cent followed by a final of 20 per cent in 1954.

British Guiana Consolidated Goldfields Ltd.

Directors:
SIR ROLAND ROBINSON, M.P. (Chairman)
W. BALLENY, C.A.; H. A. COCHRAN, O.B.E., B.Sc., M.I.M.M.; J. K. VAUGHAN MORGAN, M.P.; J. W. PARK, O.B.E., A.C.S.M., M.I.M.M.; A. C. GRIEVE

THE company was incorporated as a Public Company in 1936 for the purpose of acquiring mining rights and conducting alluvial gold dredging operations in British Guiana, particularly in the valleys of the Mahdia, Potaro and Konawaruk rivers.

As a result of prospecting work in these and other areas, the company's rights now extend over 41,000 acres, in which the total yardage of dredgeable ground so far proved or partially proved totals 55 million cubic yards of an average value of 3.30 grains bullion per cubic yard.

The total issued share capital of the company amounts to £294,628, of which 30 per cent is held by the Colonial Development Corporation, which has also provided finance by way of secured loans of £588,000 for the development of the Potaro and Konawaruk areas.

Since the company commenced operations in British Guiana, its dredges have worked some 23 million cubic yards of ground yielding a total of 190,600 fine ounces of gold, or an average of 3.6 grains fine per cubic yard.

The company's first 5 cu. ft. bucket dredge started operations in the Mahdia river area in 1937 and operated continuously from that date until April, 1955, when the payable ground in the Mahdia area was exhausted, and operations ceased. During that period it dredged 15,750,000 cubic yards and won 117,542 fine ounces of gold. This dredge has now been dismantled.

The company's second 6 cu. ft. bucket dredge started dredging in the Potaro river area in 1951, and during 1955 dredged 1,853,000 cu. yd. from which 17,974 fine ounces of gold were won, equivalent to 4.6 grains of fine gold per cu. yd.

The company's third 10½ cu. ft. bucket dredge now being built in the Konawaruk area is nearing completion. It is expected to commence operating in 1956.

Apart from the Potaro and Konawaruk areas, the company has prospecting rights in the valleys of the Mowassie and Puruni rivers and Tiger Creek. Prospecting is at present confined to the Puruni area.

A subsidiary company, the Potaro Hydro-Electric Co. Ltd., was incorporated in British Guiana in June, 1954. Construction of hydro-electric works at Tumatumari Falls on the Potaro river, the first in the Colony, commenced in 1954. Unseasonable flood conditions during 1955 delayed construction, but plant will be installed in 1956 to provide power for both the Potaro and Konawaruk dredges.

The Potaro Hydro-Electric Company also has been fortunate in obtaining from the Colonial Development Corporation the necessary finance for the project.

The company's main camp is situated at Tumatumari, with a subsidiary camp at Konawaruk.

RESULTS FOR THE YEAR 1955

Yardage:	... ...	1,958,847 cu. yds.
Recovery:	... ...	18,588 fine ounces
	Revenue:	£230,144.

After providing for operating costs, taxation, depreciation and amortisation, interest on loans and dividend of 5 per cent less income tax, the balance of profit to be carried forward to 1956 amounts to £22,604.

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National Coal Board

ORDER PLACED: October 1952 INSTALLED: October 1952	SIZE OF PUMP: 2"
MATERIAL HANDLED: Coal Washery Effluent	RATE OF DISCHARGE: 60 gallons per minute
TOTAL HEAD: 85 ft.	

OPERATIONAL REPORT: JANUARY

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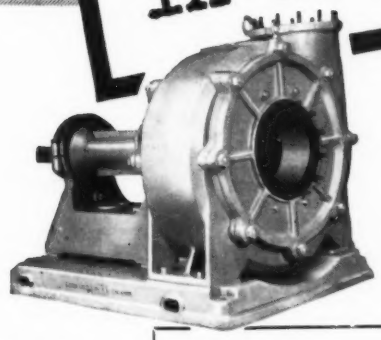

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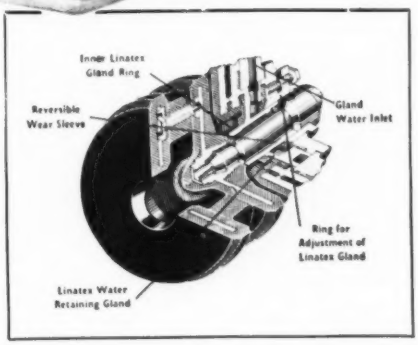
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